Implementation framework for Solar Agriculture Pump Programme

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SHAKTI
SUSTAINABLE ENERGY
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Abbreviations

Acronym	Full form
AC	Alternating Current
CSR	Corporate Social Responsibility
DC	Direct Current
DEA	Department of Economic Affairs
DIA	District Implementing Agency
Discom	Distribution Companies
ETCs	Extension Training Centres
GBS	General Budget Support
GPRS	General packet radio service
Ha	Hectare
HP	Horse power
IEC	Information, Education and Communication
INR	Indian Rupees
IREDA	Indian Renewable Energy Development Agency
ISAC	Integrated Scheme of Agriculture Cooperation
ISAC&S	Integrated Scheme on Agri- Census & Statistics
ISAM	Integrated Scheme of Agriculture Marketing
JNNSM	Jawaharlal Nehru National Solar Mission
kW	Kilowatt
kWp	Kilowatt-peak
M&E	Monitoring and Evaluation
MDWS	Ministry of Drinking Water and Sanitation
MIDH	Mission for Integrated Development of Horticulture Mission
MIS	Management Information Systems

MNRE	Ministry of New and Renewable Energy
MoA	Ministry of Agriculture
MoP	Ministry of Power
MoRD	Ministry of Rural Development
MW	Megawatt
MWR	Ministry of Water Resources
NABARD	National Bank for Agriculture and Rural Development
NCIP	National Crop Insurance Programme
NFSM	National Food Security Mission
NMAET	National Mission on Agricultural Extension & Technology
NMOOP	National Mission on Oil Seeds and Oil Palm
NMSA	National Mission on Sustainable Agriculture
NRDWP	National Rural Drinking Water Programme
PMKSY	Pradhan Mantri Krishi Sinchayee Yojana
PV	Photo voltaic
RESCO	Renewable Energy Service Company
RFID	Radio Frequency Identification Tag
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
RKVY	Rashtriya Krishi Vikas Yojana
RRBs	Regional Rural Banks
SCADA	Supervisory Control and Data Acquisition
SIA	State Implementing Agency
SIRDs	State Institutes of Rural Development
SPV	Solar Photo Voltaic
VFD	Variable Frequency Drives
W	Watt
Wp	Watt-peak

Chapter 1
Introduction to Solar Agriculture Pump Scheme

1 Introduction to Solar Agriculture Pump Scheme

1.1 Background

The programme for deployment of solar agriculture pumps was initiated by the Ministry of New and Renewable Energy (MNRE) in 1992. However, the costs were prohibitive for large-scale implementation of the pumps. The solar pump initiative was re-launched as part of the off-grid and decentralized component of the Jawaharlal Nehru National Solar Mission (JNNSM) in 2010, which had a total target of 200 MW for solar off-grid applications in Phase I. As part of the JNNSM programme, MNRE supports implementation of solar pumps for irrigation and community drinking water through capital subsidy assistance. In addition to the subsidy provided by MNRE, states provide subsidy assistance in the range of 40% to 60% for implementation of solar agriculture pump programmes.

The present Government, in its Union budget 2014-15, had emphasized the importance of solar pumps and allocated INR 400 Crore for installation of 1 lakh solar agricultural pump sets.

Thereafter, Ministry of New and Renewable Energy (MNRE) launched the "Solar Pumping Programme for Irrigation and Drinking Water" for promoting solar agricultural pump installations in the country. The programme targets to implement one lakh solar pumps every year and it is expected that by the year 2020-2021, at least 10 lakhs solar pumps will be deployed.

Out of the one lakh solar pumps to be implemented in the year 2014-15:

- 50,000 Nos. of solar pumps earmarked for irrigation purpose;
- 20,000 Nos. of solar pumps for drinking water, and;
- 30,000 solar pumps to be implemented through NABARD

As part of this target, in December 2014, MNRE reallocated targets to various states for installation of 54,394 solar pumps for irrigation and 15,330 solar pumps for drinking water.

1.2 Importance of Solar Pumps for India

Currently, the country has approximately 18 million grid connected pump sets and 7 million diesel pump sets. The farms are partly irrigated due to erratic grid supply and high cost of diesel thus impacting crop yield. Solar pumping system is a potential solution to this problem.

Solar power, with its ability to provide daytime on-demand power, can meet the agricultural power demand without being connected to the grid. Amongst different consumer categories, the correlation between solar power generation and the demand with respect to generation timing is highest for the agriculture category. Moreover, unlike industrial and residential consumption, agricultural water pumping can tolerate certain level of intermittency in power output, which is a characteristic of solar power.

Value Proposition for Key Stakeholders

Government

- Reduction in electricity subsidy burden and savings on account of new connections, augmentations etc.
- Reduction in distribution companies' losses
- Environmental benefits by reduction in greenhouse gas (GHG) emissions
- Positive impact on state's GDP by increased agriculture productivity and creating employment
- Water conservation through adoption of integrated irrigation system like drip irrigation and water harvesting with solar pumps

Beneficiaries

- Convenience and safety – reliable energy during day time
- Crop yield enhancement – by enabling high value horticulture crops
- Reduction in high expenditure on diesel and relief from tough logistics of repeatedly procuring diesel from far areas (There exists economic case for the replacement of diesel pump with solar pump which is described in Annexure I).
- Ownership of the asset with limited investment –becomes cost effective for farmers after certain period of time
- Additional source of power for home lighting, mobile charging etc.
- Overall improvement of energy access and livelihood in the rural areas

Objectives

This report provides an indicative framework to the states for implementation of the MNRE's solar agriculture pump programme. The key objectives are as follows:

- Identification of target segments for solar pump installation
- Identification of various implementation models to provide flexibility to the state in tapping multiple funding sources and reduce dependence on subsidy
- Defining the roles and responsibilities for key stakeholders
- Defining various modes of communication for the programme
- Elaborating on the key monitoring aspects of the programme
- Feasibility of integrating solar pumping programmes with electricity for lighting/livelihood

1.3 Potential Solar Pump Applications

A solar pumping system consists of an array of PV panels mounted on a fixed or tracking mounting structure, connected to a water pump comprising of an AC or a DC motor, suction and delivery pipes and electrical switchgears. A DC pump could be driven by a brushed or brushless permanent magnet DC motor. In case of an AC motor, an inverter or a variable frequency drive (VFD) is used to convert DC power from the solar array to AC power required by the pump.

The versatility and robustness of solar pumps make them suitable for practically most of the conventional pumping applications. Thus, besides irrigation, solar pumping systems can be used in urban and rural municipal services, residential applications amongst various other applications. The different types of solar pump are:

a. Grid Connected Pumping

Solar pumps can be installed in areas where the electricity grid is connected to irrigation pumps. As irrigation needs are intermittent, between 200 to 250 days in a year, a solar pump can feed surplus power back in the grid in collaboration with electricity authorities and local utilities.

b. Solar Pump Mini Grid

Feeder segregation is being carried out in many rural areas to separate irrigation pumping from rural residential homes. A dedicated transformer is connected to a cluster of irrigation pumps supplying power for fixed number of hours. The solar PV plant can feed power to these cluster of pumps. Additionally, the PV plant will feedback power to the grid in case surplus power is available. Pumps could act as reliable anchor loads in case of off-grid mini grids.

c. Diesel Pumps

In areas with no grid connectivity or unreliable power, there is high expenditure on diesel which make small and marginal farming economically unviable. Additionally, most of these diesel pumps are highly inefficient. A programme that replaces diesel pumps with solar PV pumps would also help in reducing pollution besides immensely benefiting the farmer.

d. Community Solar Pumps or Water as a Service

In some states, farmers with electricity/diesel connection, sell (or barter) water to neighboring farmers who do not have pumping system. In these situations, either solar pump (along with panels) can be portable or water as a service needs to be encouraged. The pumps would thus be owned by large farmers or community and the service of providing water to other farmers shall be provided. This could help in developing local enterprises and increasing local employment opportunities.

e. Micro Solar Pumps

Farmers who grow vegetables on small sized plots largely use manual irrigation methods like swing bucket, hand pumps or treadle pumps. A small micro solar pump (panel capacity of 75 Wp to 500 Wp with a pump of 0.1 HP to 0.5 HP) can perform similar functions as a manually operated pump. These micro solar pumps can also find applications in rural schools and health centers for drinking water.

f. Water Management

Solar pumps utilize water in the most efficient manner when combined with water conservation technologies like drip irrigation and rain water harvesting. This integration will also help farmers in diversifying to more remunerative horticulture/cash crops. This could bring additional land under irrigation and result in increased farmers' income.

Along with irrigation, solar pumps can also be used for drinking water supply and reduce dependence on expensive diesel and electric pumping systems. Government has successfully implemented an innovative Solar Energy Based Dual Pump Piped Water Supply Scheme in 2013-14, in many districts to meet drinking water needs through solar pump.

Chapter 2
Implementation Framework for States

2 Implementation Framework for States

This section provides an approach to the state to implement the solar pumping programme through:

- Identification of districts and target beneficiaries
- Identification of implementation model depending on the sources of funds
- Establishing the organizational structure, defining roles and responsibilities of key stakeholders and selection of suppliers

2.1 Identification of Districts and Target Beneficiaries for Implementation of the Programme

The states can identify the target number of pumps replaceable under the programme based on the following factors:

- Availability of funds: Identification of various sources of funds to reduce dependence on subsidy (power savings subsidy, integration of schemes etc.)
- Water resource availability in the state
- Affordability of the farmers

The states may prioritize their target by focusing on few districts and then replicating the learnings in other districts. There is a rationale for the states in doing so, considering techno-economic and service supply chain perspective.

The following methodology (as described in Figure 1) can be adopted by the states to arrive at the target number of replaceable pumps:

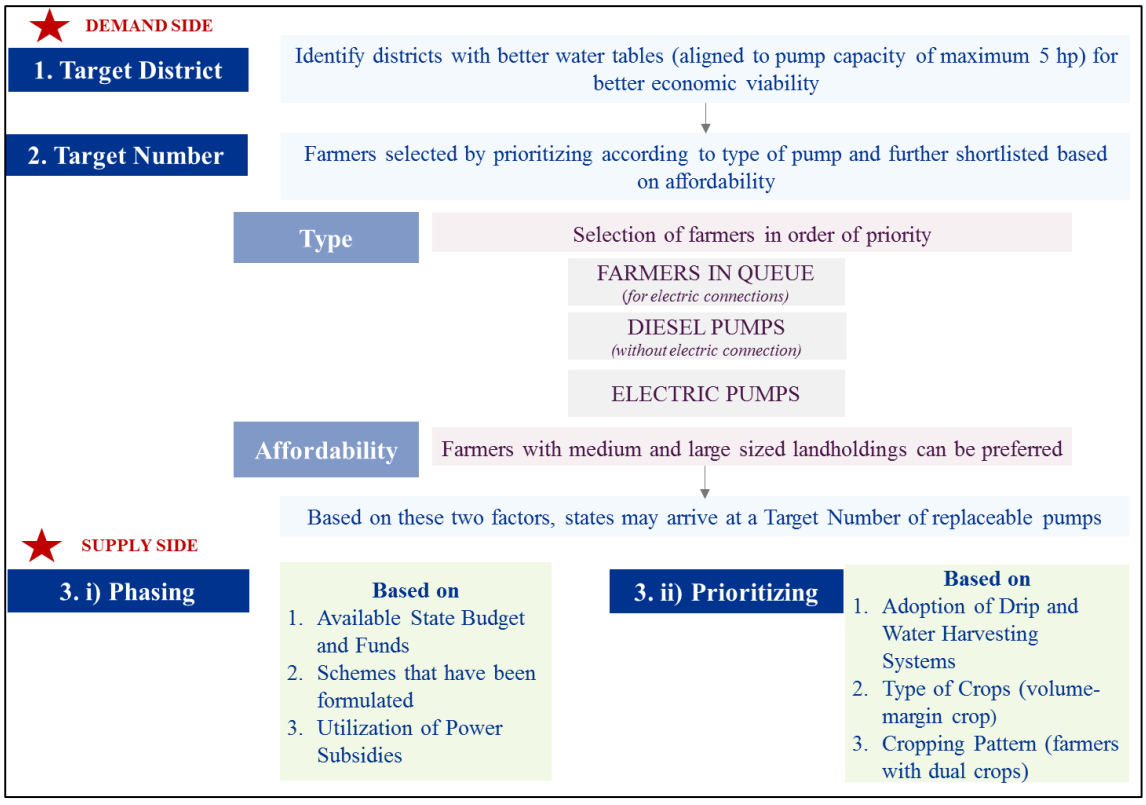


Figure 1: Methodology for states to determine target number of pumps

1. Identifying and selecting target districts having better water tables. *(Demand side)*
2. The states may arrive at a target number of replaceable pumps by prioritizing the farmers; starting with farmers in queue for electric pumps followed by farmers using diesel pumps (without electric connection) and then the farmers using electric pumps could be targeted. The targeted farmers can be further shortlisted according to their affordability (size of landholdings; medium and large). *(Demand side)*
3. The target number of replaceable pumps can then be phased out based on available state budget and funds, integration of schemes and utilization of power subsidies. This phasing can be carried out by simultaneously prioritizing the target on the basis of adoption of drip irrigation and water harvesting systems, type of crops (volume-margin crop) and cropping pattern (farmers with dual crops). *(Supply side)*

An indicative template for shortlisting the districts has been provided in Annexure II of this document.

2.2 Implementation Models

2.2.1 Need for the Implementation Models

Various Implementation models have been proposed for the states which can assist in identifying various sources of funds and implementation mechanisms in order to create a sustainable and scalable solar pump programme.

Critical Success Factors of Implementation Models

- Identification of the right districts.
- Designated implementation agency of the program that understands issues and requirements of the beneficiaries.
- Publicity campaign to generate demand, pilot demonstration, state officials' regular site visit to increase awareness
- Robust monitoring mechanism encompassing tracking of performance and benefits of the program

2.2.2 Overview - Various Implementation Model Options

The following implementation model options have been identified based on funding sources, subsidy structure and implementing institution :

1. Conventional Model
2. Loan Model
3. RESCO Model
4. Open Market Model
5. "Water as service" Model

Each model proposes different share of state subsidy (thereby different share of beneficiary contribution) and methods to tap various sources of funds.

2.2.3 Details on Potential Implementation Models of the Programme

MNRE provides Central financial assistance for the programme through the General Budget Support (GBS) every year. The states can identify various implementation models which leverage the subsidy provided under this programme. The models outlined below can be implemented

either by the State Government and State Implementing Agencies or through NABARD and banks like RRBs.

I. Through State Governments

The State Government will nominate a designated agency to implement the programme in the state. The designated Implementing Agency could be the State Nodal Agency for Renewable energy, Horticulture or Agriculture department, financial institution or any state entity having the capability to implement a large scale solar pump programme. The designated agency must be supported by a dedicated and trained team. It would be advantageous if the designated agency has field presence.

Some of the possible models for implementation are:

2.2.3.1 Model 1: Conventional Model

Model Description

This model has already been implemented in many parts of the country. The funding pattern under this model is described in Figure 2 as follows:

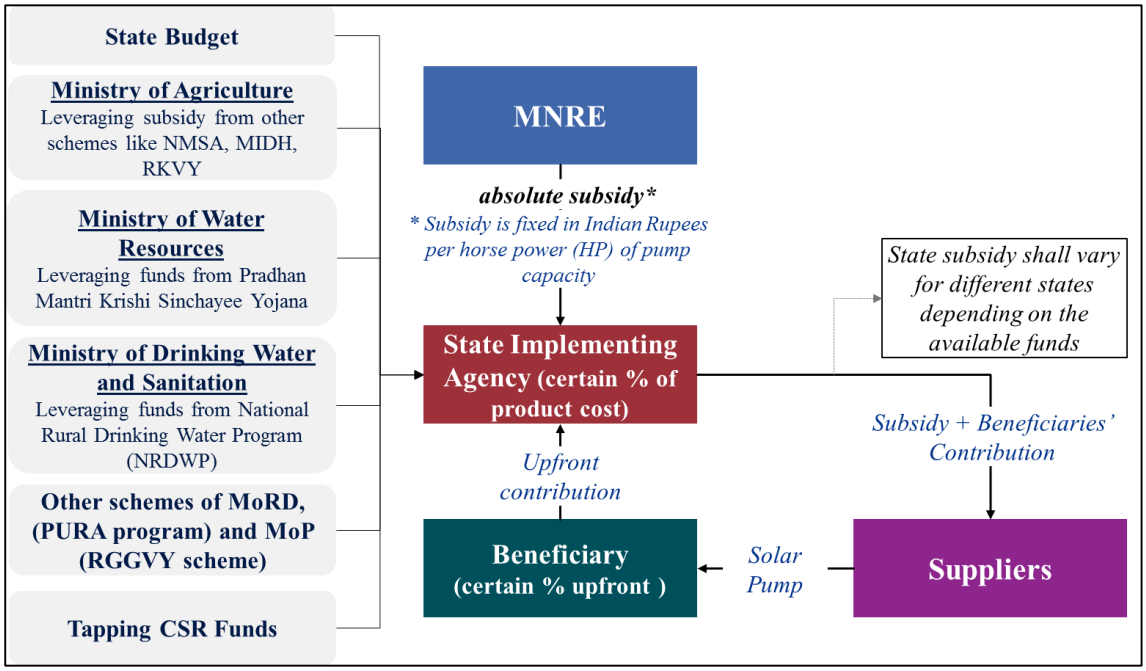


Figure 2: Model 1- Conventional Model

- MNRE provides Central Financial Assistance in absolute amount as provided in Annexure III*.

  *Note: - *absolute value – subsidy is fixed in Indian Rupees per horse power (HP) of pump capacity.*

- State subsidy could be at least equivalent to the MNRE subsidy amount and could vary for different states depending on the available funds. States can support the programme through other sources such as leveraging subsidy by integrating various agriculture /water schemes, from state budget and other inter-department sources etc.
- The Beneficiary contribution will vary depending on the contribution made by State.

The State designated agency can integrate solar pumps with water harvesting and drip irrigation or any other relevant schemes as may be the requirement in the area. Currently, a number of programmes and schemes are being implemented to benefit farmers and rural population under various ministries of the government. States may decide to integrate some of the relevant schemes and leverage funds/subsidy from the schemes for supporting the solar pump programme. Details of these programmes and schemes have been described in Annexure IV.

Integration of schemes with the solar programme would provide end-to-end solution to challenges around irrigation by judiciously combining standalone programmes, mobilizing stakeholders and creating synergies to formulate a comprehensive solution strategy. The integration would also provide a means to leverage subsidy and funds from other schemes to the solar programme. This approach can facilitate the solar pump installation and increase energy access for farmers and also provide farmers opportunity to diversify to remunerative high-value crops, increase productivity and also improve the livelihood.

It is important to establish a robust organizational structure to facilitate the implementation of the programme, as funds are arranged through collaboration and interfacing with other state/central agencies. Coordination and integration among different ministries, MNRE, MoA, MWR, MWDS, MoRD and MoP is essential for utilization of these funds and effective implementation of the integrated programme.

Some additional sources like Corporate Social Responsibility (CSR) funds can be tapped for initial pilot installations.

Salient Features and Critical Success Factors of the Model

Salient Features

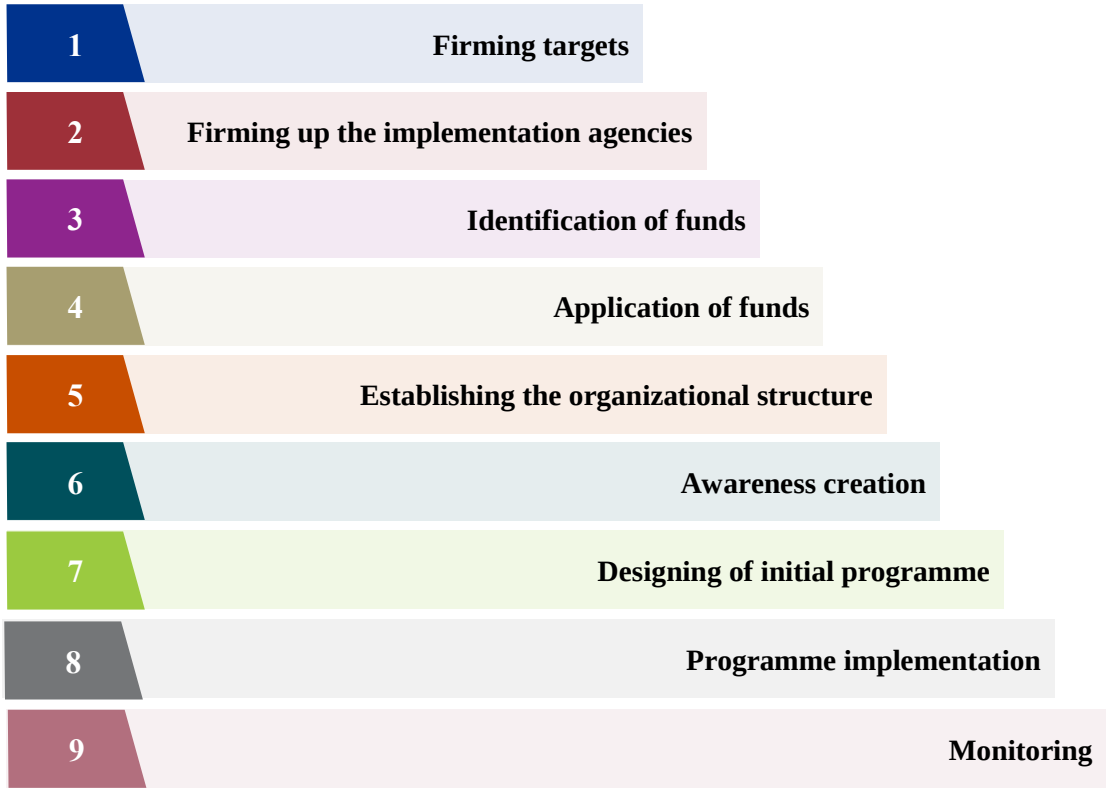
- Simplistic model which is already implemented in many parts of the country
- Reduces the dependence on financing or other external funding by leveraging subsidies from other schemes

Critical Success Factors

- Pro-activeness of State Implementing Agencies to integrate various schemes
- Availability of funds from State budget

Implementation Roadmap

The following roadmap could assist the states in implementing the solar pump programme based on the above described model:



1 Firming Targets

- It is essential for the state to define year-wise targets under the scheme and also provide timelines to achieve these targets.
- States may prioritize their target by focusing on few districts say 4-5 and replicating in other districts.

2 Firming up the Implementation Agencies

- State Government will nominate a designated agency to implement the programme in the state.
- The designated Implementing Agency could be the State Nodal Agency for Renewable energy, Horticulture or Agriculture Department, financial institution or any state entity having the capability to implement large scale solar pump programmes.

3 Identification of Funds

- Once the targets are set and the districts are shortlisted, it is essential to identify the funding requirements and sources.

- In some cases, the availability of funds could determine the target. The State Implementing Agency could identify the available state budget and subsidy/unused funds available from other schemes.

4 Application of Funds

- Once the funding requirements for a particular target have been identified, the Implementing Agency would seek approval for grant of subsidy from the concerned authorities.
- The State Implementing Agency would make application for funds by:
  - Indicating MNRE for the release of subsidy amount for installation of solar pumps.
  - Coordinating with other ministries and departments for leveraging funds of other programmes towards the solar pump programme.

5 Establishing the Organizational Structure

- Along with identification of funds through collaboration and interfacing with other state/central agencies, an organizational structure is needed to facilitate the implementation of the programme.
- The State Implementation Agency can decentralize the implementation process to the district level by designating and empowering a District-level Implementing Agency.
- It is necessary to identify and communicate the responsibilities to various stakeholders for effective coordination among all entities.

6 Awareness Creation

- The District Implementing Agency may look at creating awareness by implementing pilot solar agriculture pump schemes in the target districts.
- Key programme officials could conduct regular site visits and interact with farmers to increase awareness.

7 Designing of Initial Programme

- It is important that the initial programmes are designed and executed satisfactorily, as successful operating installations foster confidence among stakeholders.
- The state may tap corporate CSR funds for pilot installations.

8 Programme Implementation

- The State Implementing Agency would define the selection criteria for beneficiaries and suppliers based on the schemes which have been integrated and select them through a transparent process.
- Some indicative tendering aspects for selection of beneficiaries and suppliers are as follows:

Tendering Aspects for Selection (*Indicative)*

Beneficiaries

- Ownership of at certain hectares of land/ *Kisan* credit card holder
- Irrigation with drip system, facility of water harvesting/storage structure
- Adopter of hi-tech agriculture horticulture activities

Suppliers

- For procurement of solar pumps, the Implementing agency may shortlist suppliers who are meeting MNRE norms
- Some of the technical and financial eligibility criteria which could be considered for selection are:
  - Track record in SPV field, supplying and commissioning of SPV pump systems
  - Turnover criteria depending on the scale of the project
  - Selection could be based on approved price range for specific pump size and pump type or lowest financial quote as may be decided by the respective State Implementing Agency. In case the selection is done on L1 (lowest financial quote) basis, suppliers could be given incentives to be L1
  - Having pump service centers in villages could be made mandatory for the bidders

- The technical specifications (as provided by MNRE) of the proposed models of SPV pump for irrigation are described in Annexure V.
- The District Implementing Agency would invite application from the beneficiaries along with a registration fees. For farmers whose applications are accepted, this amount would be adjusted later toward their share of payment for solar pump. Applications could be shortlisted on the first-come-first-serve basis or lottery, if applications exceed the target. A template for seeking beneficiaries' details has been provided in Annexure VI of this document.
- The shortlisted suppliers would conduct demonstration workshops and generate demand by marketing for their products.
- The beneficiary would have choice of the suppliers among the shortlisted. The suppliers may submit quotes to the District Implementing Agency after receiving farmer's consent.
- The District Implementing Agency would issue of work order to the suppliers and based on various milestones, would release payment to the suppliers.

9 Monitoring

- The State Implementing Agency can direct the district agencies to conduct physical inspections at the farmer's premises before installation of pumps.
- The district agencies would issue status reports during the installation process and conduct physical verification of the functioning equipment post installation.

- The State Implementing Agency could take up concurrent monitoring and post project evaluation encompassing tracking of performance and benefits of the programme as provided in Chapter 4 of this report.

2.2.3.2 Model 2: Loan Model (Financing from Lending Agencies)

Model Description

Farmers get subsidised electricity in the country, but the actual cost of supply of this subsidised power is high for State Government/utilities. If the conventional agriculture power is replaced by solar power, there will be savings on account of difference in actual cost of supply of power and the tariff paid by the farmers (net cost of agriculture power supply). There are large number of farmers in queue for electrical connections. If these farmers are provided solar pumps instead of electrical connection, there can be additional savings on account of one time network connection cost incurred by the utilities along with savings of the difference in actual cost of supply of power and the subsidised tariff paid by the farmers. These savings can instead be used to support and fund the solar pump programme by taking loans from multilateral/bilateral agencies and repaying the loan from these savings. An illustration on the percentage of loan amount which can be supported at different levels of costs of agriculture power supply is provided in Annexure VII.

The funding pattern under this model is described in Figure 3 as follows:

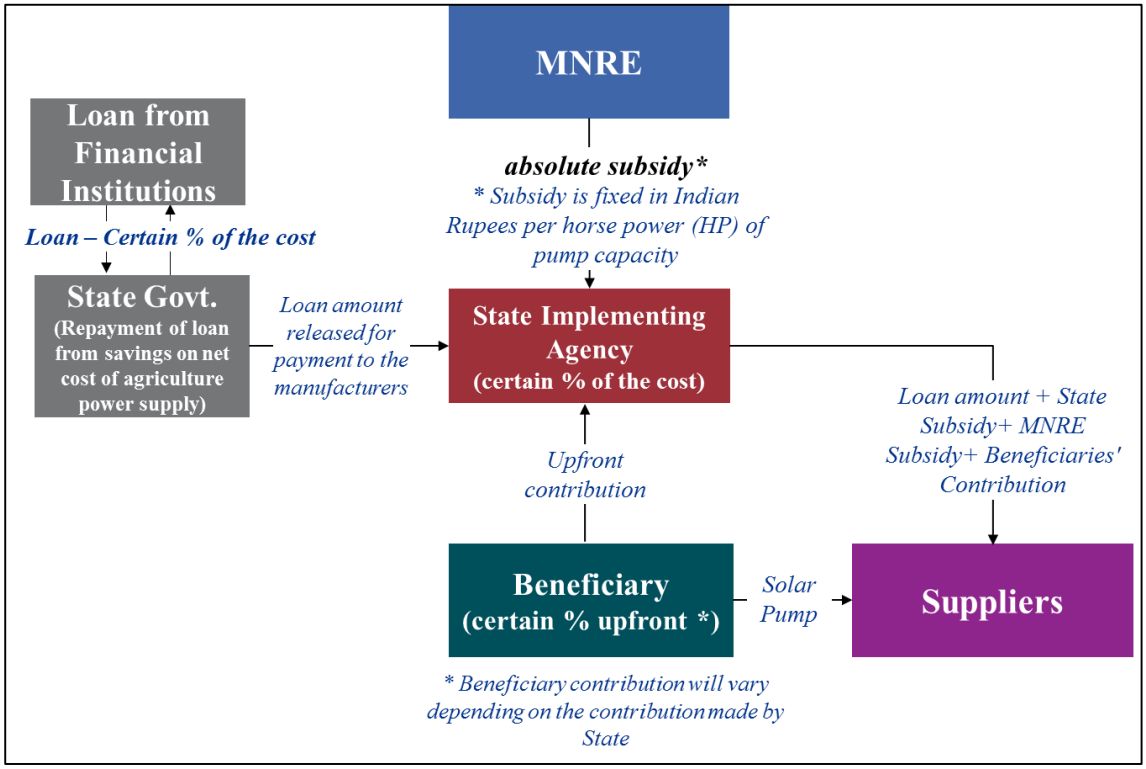


Figure 3: Model 2- Loan Model

- MNRE provides Central Financial Assistance in absolute amount as provided in Annexure III*.

  *Note: - *absolute value – subsidy is fixed in Indian Rupees per horse power (HP) of pump capacity.*

- State subsidy could be at least equivalent to the MNRE subsidy amount and could vary for different states depending on the available funds. States can support the programme through other sources such as leveraging subsidy by integrating various agriculture /water schemes, from state budget and other inter-department sources etc.
- The Beneficiary contribution would vary depending on the contribution made by State.
- Balance contribution as loan taken by State Government from financial institutions. MNRE may help the states in identifying the funding agencies and also facilitate co-ordination with DEA for approvals. The State Government would extend the loan amount to the implementing agencies for payment to the suppliers.

States may also consider loan from financial institutions like IREDA, NABARD, etc. in the near term. In the medium term, states may look at Multilateral/bilateral agencies where MNRE could help to fast-track the loan approval process.

This model would help in reducing the need of upfront capital subsidy by the states as it is utilizing savings on net cost of agriculture power supply. Some of the measures such as metering the agricultural consumers, surrendering of the electric pumps, removing the beneficiaries from queue of grid connection in subsequent years etc. could be explored to ensure that there are savings on account of replacement of conventional agriculture power with solar.

A similar model for installation of solar pumps is being implemented in states like Andhra Pradesh. The case study of the model is described in Annexure VIII.

Salient Features

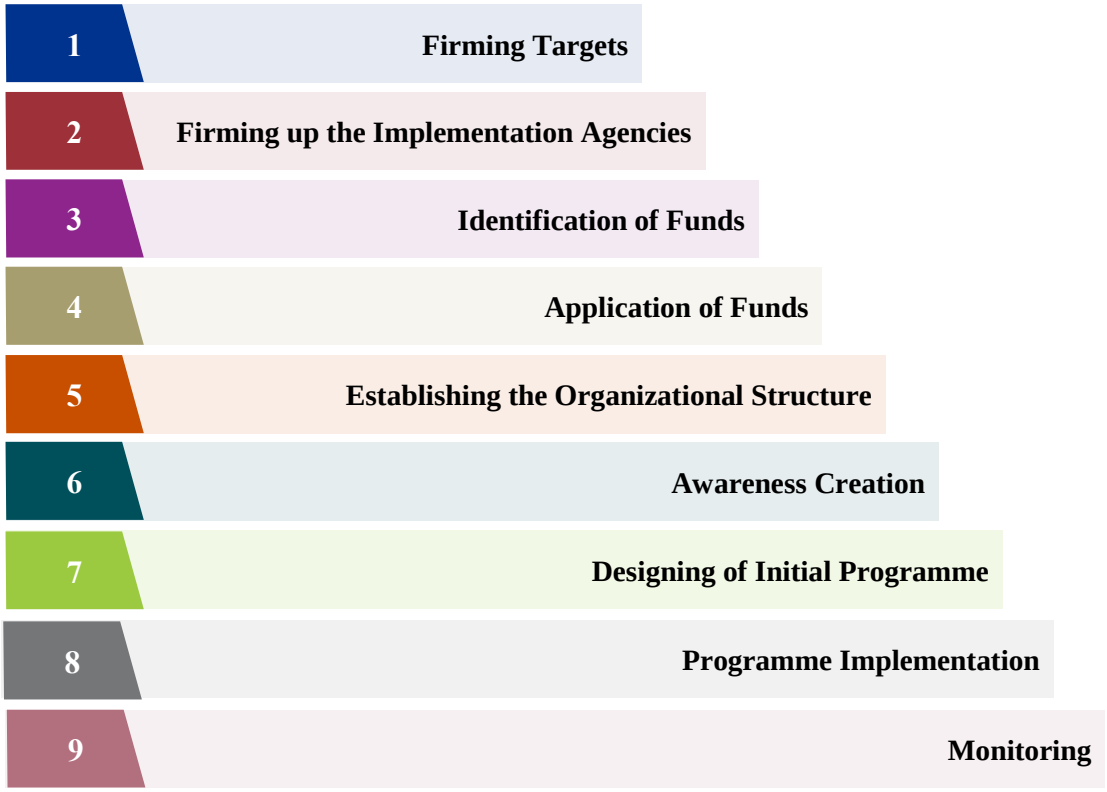
- Reduction in state subsidy burden
- Scalable model

Critical Success Factors

- Timely completion of project approval processes for funding from multilateral/bilateral agencies
- Availability of funds from State budget/integration of schemes
- Availability of agriculture power subsidy from State Budget

Implementation Roadmap

The following roadmap could assist the states in implementing the solar pump programme based on the above described model. Each step is described in detail below:



1 Firming Targets

- It is essential for state to define year-wise targets under the scheme and also provide timelines to achieve these targets.
- States may prioritize their target by focusing on few districts say 4-5 and replicating the learnings in other districts.

2 Firming up the Implementation Agencies

- State Government will nominate a designated agency to implement the programme in the state.
- The designated Implementing Agency could be the State Nodal Agency for Renewable energy, Horticulture or Agriculture Department, financial institution or any state entity having the capability to implement large scale solar pump programmes.

3 Identification of Funds

- Once the targets are set and the districts are shortlisted, it is essential to identify the funding requirements and sources.

- In some cases, the availability of funds could determine the target. The State Implementing Agency could identify the available state budget and subsidy/unused funds available from other schemes.
- The States may borrow loans from multilateral/bilateral and other financing agencies. MNRE would assist the states in identifying these agencies.

4 Application of Funds

- Once the funding requirements for a particular target have been identified, the Implementing Agency would seek approval for grant of subsidy from the concerned authorities.
- The State Implementing Agency would make application for funds by:
  - Indicating MNRE for the release of subsidy amount for installation of solar pumps.
  - Coordinating with other ministries and departments for leveraging funds of other programmes towards the solar pump programme.
  - Coordinating with the State Government to release the loan borrowed from lending agencies for payment to suppliers.

5 Establishing the Organizational Structure

- Along with identification of funds through collaboration and interfacing with other state/central agencies, an organizational structure is needed to facilitate the implementation of the programme.
- The State Implementation Agency can decentralize the implementation process to the district level by designating and empowering a District-level Implementing Agency.
- It is necessary to identify and communicate the responsibilities associated with various stakeholders for effective coordination among all entities.
- MNRE would facilitate funding from lending agencies and also coordinate with the Department of Economic Affairs (DEA).

6 Awareness Creation

- The District Implementing Agency may look at creating awareness by implementing pilot solar agriculture pump schemes in the target districts.
- Key programme officials may conduct regular site visits and interact with farmers to increase awareness.

7 Designing of Initial Programme

- It is important that the initial programmes are designed and executed satisfactorily, as successful operating installations foster confidence among stakeholders.
- The state may tap corporate CSR funds for pilot installations.

8 Programme Implementation

- The State Implementing Agency would define the selection criteria for beneficiaries and suppliers based on the schemes which have been integrated and select them through a transparent process. Some of these criteria have been discussed in Section 2.3.1.3.
- The District Implementing Agency would invite application from the beneficiaries along with a registration fees. For farmers whose applications are accepted, this amount would be adjusted later toward their share of payment for solar pump. Applications could be shortlisted on the first-come-first-serve basis or lottery, if applications exceed the target. A template for seeking beneficiaries' details has been provided in Annexure VI of this document.
- The shortlisted suppliers would conduct demonstration workshops and generate demand by marketing for their products.
- The beneficiary would have choice of the suppliers among the shortlisted. The suppliers may submit quotes to the District Implementing Agency after receiving farmer's consent.
- The District Implementing Agency would issue of work order to the suppliers and based on various milestones, will release payment to the suppliers.
- The State Government would repay the loan amount to the multilateral agencies through savings on net cost of agriculture power supply.

9 Monitoring

- The State Implementing Agency can direct the District agencies to conduct physical inspections at the farmer's premises before installation of pumps.
- The District agencies would issue status reports during the installation process and conduct physical verification of the functioning equipment post installation.
- The State Implementing Agency could take up concurrent monitoring and post project evaluation encompassing tracking of performance and benefits of the programme as provided in Chapter 4 of this report.

2.2.3.3 Model 3: RESCO Model (Renewable Energy Service Company)

Model Description

Organisation engaged in fee for services models of delivery like Renewable Energy Service Companies (RESCO) could also be possible channel for implementing solar pumping programme. The funding pattern under this model is described in Figure 4 as follows:

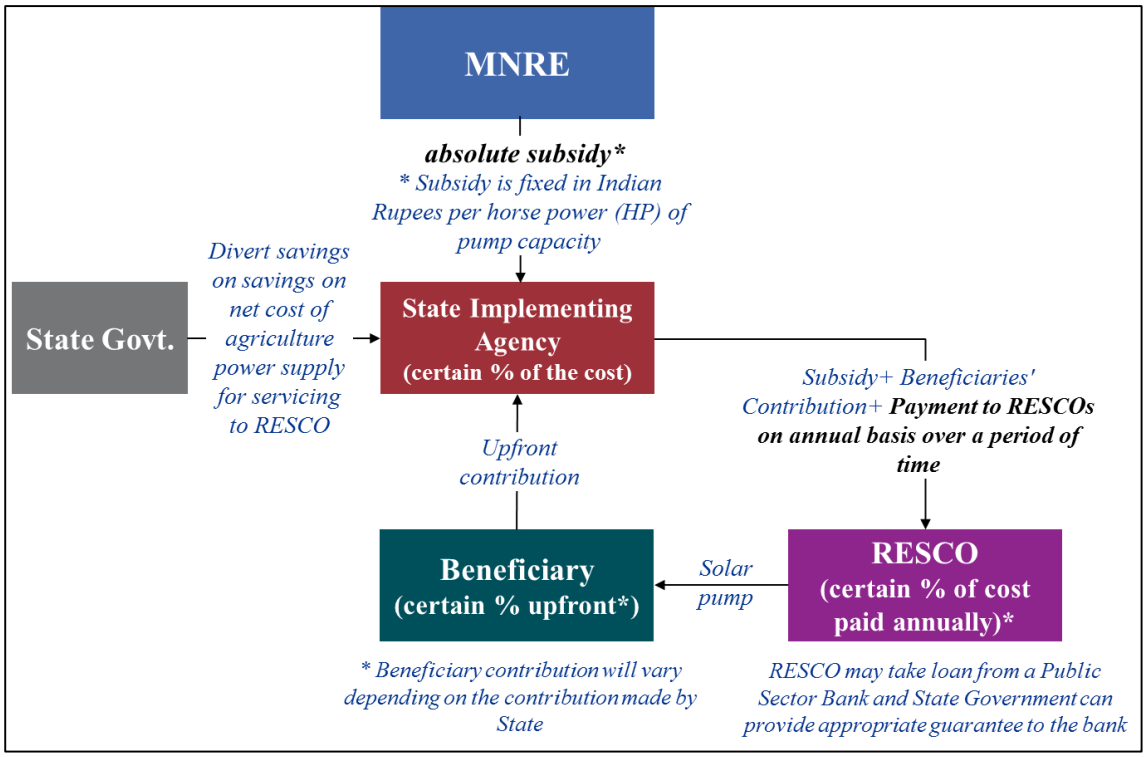


Figure 4: Model 3- RESCO Model

- MNRE provides Central Financial Assistance in absolute amount as provided in Annexure III*.
- *Note: - *absolute value – subsidy is fixed in Indian Rupees per horse power (HP) of pump capacity.*
- State subsidy could be at least equivalent to the MNRE subsidy amount and could vary for different states depending on the available funds. States can support the programme through other sources such as leveraging subsidy by integrating various agriculture /water schemes, from state budget and other inter-department sources etc.
- The Beneficiary contribution would vary depending on the contribution made by State.
- Balance contribution may be to be paid to the RESCOs annually over a time by the State Distribution companies from the savings on net cost of agriculture power supply. Appropriate payment security may be provided by the State Government to the RESCOs in the form of Letter of Comfort.

Salient Features and Critical Success Factors

Salient Features

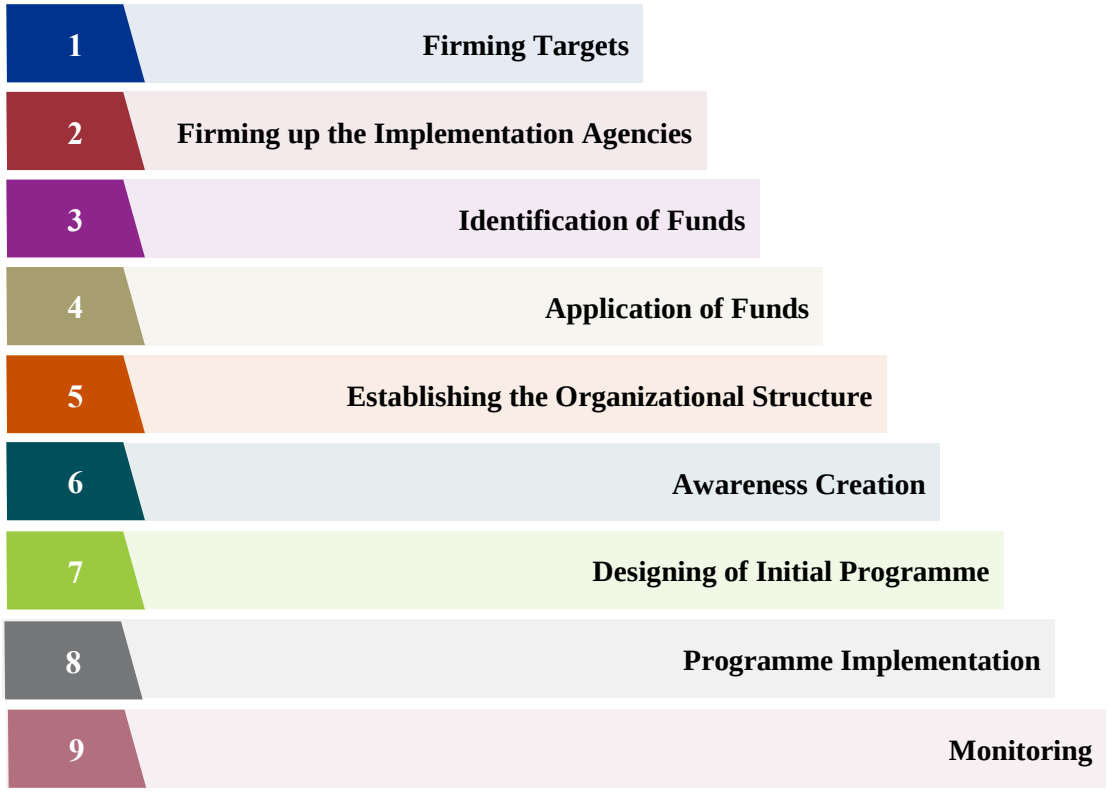
- Reduction in state subsidy burden – due to deferred payment to the RESCOs
- Model can be implemented faster as the loan is being arranged by the RESCOs
- The ownership of the asset would remain with State Implementing Agency till RESCO are paid the complete amount after which it could be transferred to the farmers. The State Implementing Agency, banks and RESCO may enter into a tripartite agreement

Critical Success Factors

- Availability of players with upfront investment capabilities
- Adequate Payment Guarantees to RESCOs
- Surrender of the grid connection or electric pump

Implementation Roadmap

The following roadmap could assist the states in implementing the solar pump programme based on the above described model. Each step is described in detail below:



1 Firming Targets

- It is essential for the state to define year-wise targets under the scheme and also provide timelines to achieve these targets.
- States may prioritize their target by focusing on few districts say 4-5 and replicating in other districts.

2 Firming up the Implementation Agencies

- State Government will nominate a designated agency to implement the programme in the state.

- The designated Implementing Agency could be the State Nodal Agency for Renewable energy, Horticulture or Agriculture Department, financial institution or any state entity having the capability to implement large scale solar pump programmes.

3 Identification of Funds

- Once the targets are set and the districts are shortlisted, it is essential to identify the funding requirements and sources.
- In some cases, the availability of funds could determine the target. The State Implementing Agency could identify the available state budget and subsidy/unused funds available from other schemes.

4 Application of Funds

- Once the funding requirements for a particular target have been identified, the Implementing Agency would seek approval for grant of subsidy from the concerned authorities.
- The State Implementing Agency would make application for funds by:
  - Indicating MNRE for the release of subsidy amount for installation of solar pumps.
  - Coordinating with other ministries and departments for leveraging funds of other programmes towards the solar pump programme.
  - Coordinating with State Government for adequate payment guarantee for the RESCOs

5 Establishing the Organizational Structure

- Along with identification of funds through collaboration and interfacing with other state/central agencies, an organizational structure is needed to facilitate the implementation of the programme.
- The State Implementation Agency can decentralize the implementation process to the district level by designating and empowering a District-level Implementing Agency.
- It is necessary to identify and communicate the responsibilities associated with various stakeholders for effective coordination among all entities.
- It is essential that the State Implementing Agency coordinates with the State Government for appointing the RESCO.

6 Awareness Creation

- The District Implementing Agency may look at creating awareness by implementing pilot solar agriculture pump schemes in the target districts.
- Key programme officials may conduct regular site visits and interact with farmers to increase awareness.

7 Designing of Initial Programme

- It is important that the initial programmes are designed and executed satisfactorily, as successful operating installations foster confidence among stakeholders.

- The state may tap corporate CSR funds for pilot installations.

8 Programme Implementation

- The State Implementing Agency would define the selection criteria for beneficiaries and RESCOs based on the schemes which have been integrated and select them through a transparent process. Some of these criteria have been discussed in Section 2.3.1.3.
- The District Implementing Agency would invite application from the beneficiaries along with a registration fees. For farmers whose applications are accepted, this amount would be adjusted later toward their share of payment for solar pump. Applications could be shortlisted on the first-come-first-serve basis or lottery if applications exceed the target. A template for seeking beneficiaries' details has been provided in Annexure VI of this document.
- The shortlisted RESCOs would conduct demonstration workshops and generate demand by marketing for their products.
- The beneficiary would have choice of RESCO among the shortlisted. The RESCO may submit quotes to the District Implementing Agency after receiving farmer's consent.
- The District Implementing Agency shall release part of the payment to the RESCOs based on various milestones.
- The State Implementing Agency would pay the balance contribution to RESCOs annually over a time through savings on net cost of agriculture power supply.

9 Monitoring

- The State Implementing Agency can direct the District agencies to conduct physical inspections at the farmer's premises before installation of pumps.
- The District agencies would issue status reports during the installation process and conduct physical verification of the functioning equipment post installation.
- The State Implementing Agency could take up concurrent monitoring and post project evaluation encompassing tracking of performance and benefits of the programme as provided in Chapter 4 of this report.

II. Through NABARD and banks like RRBs

2.2.3.4 Model 4: Open Market Model

Model Description

The Ministry will place central subsidy with NABARD to finance the pumps through RRBs/ Commercial Banks. MNRE subsidy in this case in absolute value has been provided in Annexure III.

Depending on the affordability of the farmers, there are two options of funding under this model:

Option A. ***For Farmers who can provide security for the loan***

The funding pattern under this option is described in Figure 5 as follows:

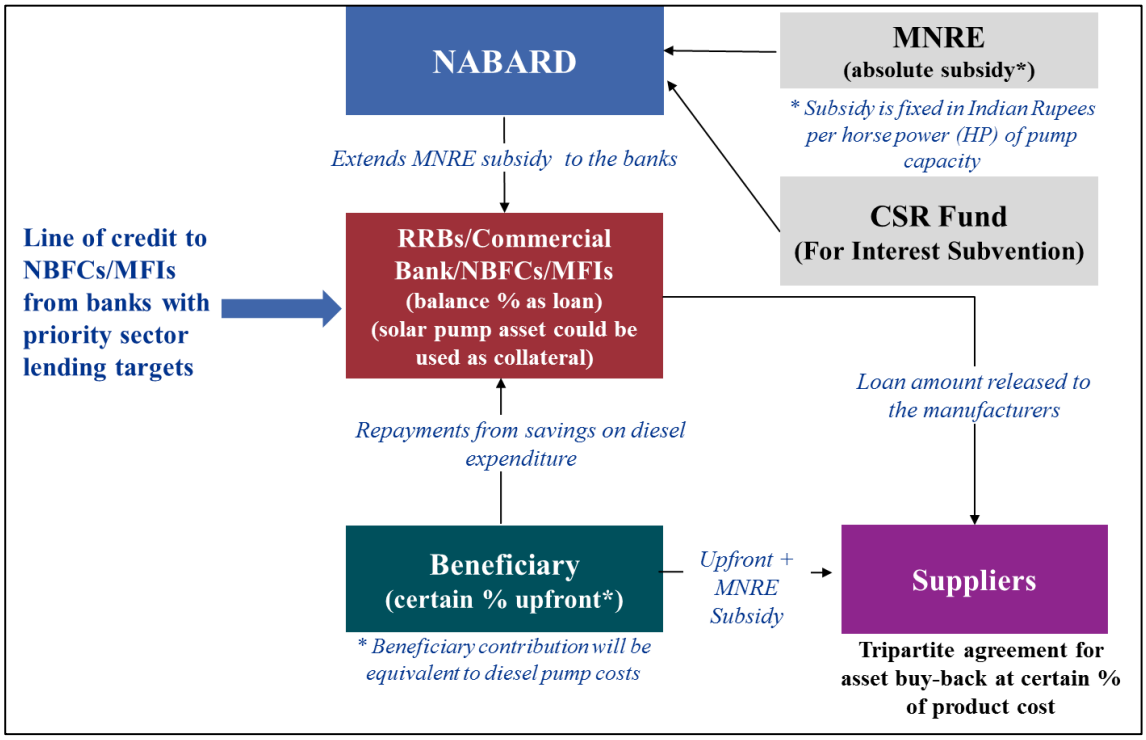


Figure 5: Model 4a- Open Market Model: for farmers who can provide security for loan

- The Ministry will place central subsidy with NABARD to finance the pumps through RRBs/ Commercial Banks. NABARD will also extend the MNRE subsidy to the RRBs/ Commercial Banks in absolute amount as provided in Annexure III*.

  *Note: - *absolute value – subsidy is fixed in Indian Rupees per horse power (HP) of pump capacity.*

- The beneficiary upfront contribution - 20% of the product cost.
- Balance contribution as loan to beneficiary through RRBs/ Commercial Banks. The beneficiary would be free to go to any of the RRBs/ Commercial Banks' branches and avail subsidy along with loan for the remaining amount as per terms and conditions of the participating bank. Solar pump asset may also be used as collateral by the banks if suppliers are willing to buy back the asset.
- The beneficiaries would repay the loan amount to the banks over the loan tenure.

Option B. ***For Farmers who do not have security - Loan amount up to INR 1 lakh does not require security***

The funding pattern under this option is described in Figure 6 as follows:

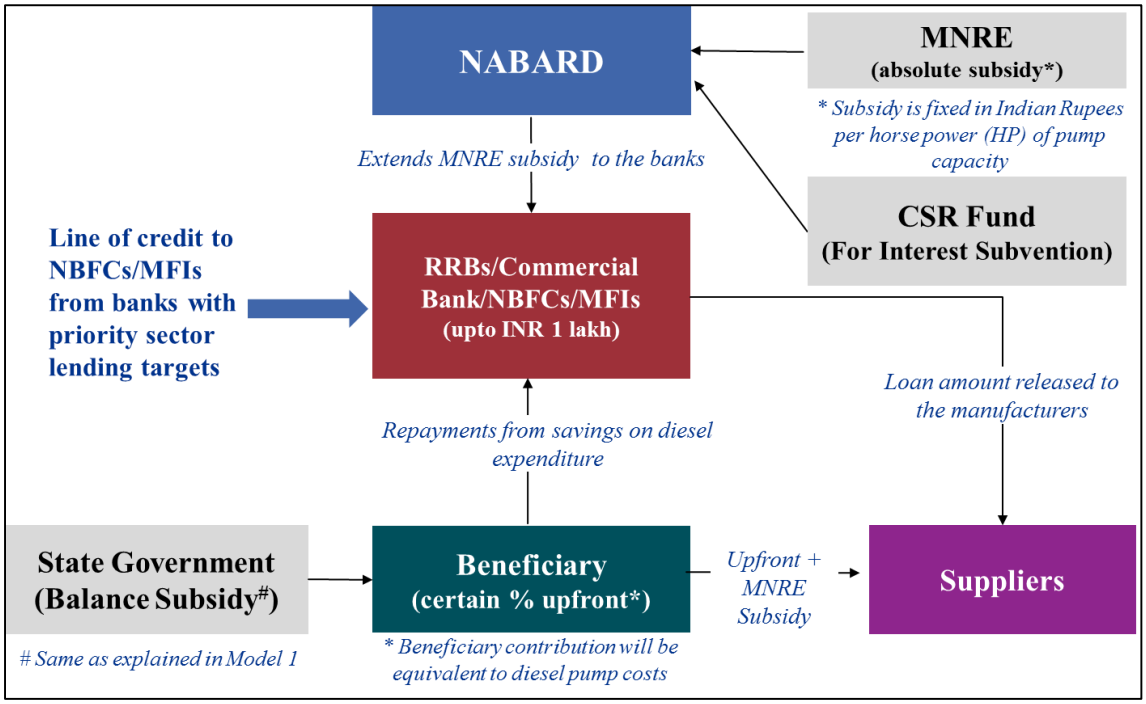


Figure 6: Model 4b- Open Market Model: for farmers who do not have security

- The Ministry will place central subsidy with NABARD to finance the pumps through RRBs/ Commercial Banks. NABARD will also extend the MNRE subsidy to the RRBs/ Commercial Banks which in this case will be 40% of the benchmark cost.
- The beneficiary upfront contribution - 20% of the product cost.
- Loan of INR 1 lakh could be availed by the beneficiary through RRBs/ Commercial Banks. The beneficiary would be free to go to any of the RRBs/ Commercial bank's branches and avail subsidy along with loan as per terms and conditions of the participating bank. The beneficiaries would repay the loan amount to the banks over the loan tenure.
- The Balance contribution could be funded through the State Government through state budget or additional sources of funds. States' contribution could be directly provided to the beneficiaries.

In case the farmer is unable to repay the loan amount, options like buy back of asset by the suppliers at certain percentage of the total cost could be explored. A Tripartite agreement may be signed by the suppliers for asset buy back at certain percentage of the total cost. NABARD may also look at different EMI models to encourage repayment of loans by the beneficiaries (for example: making last EMI free on payment of all previous EMIs, etc.).

Salient features and Critical success factors

Salient Features

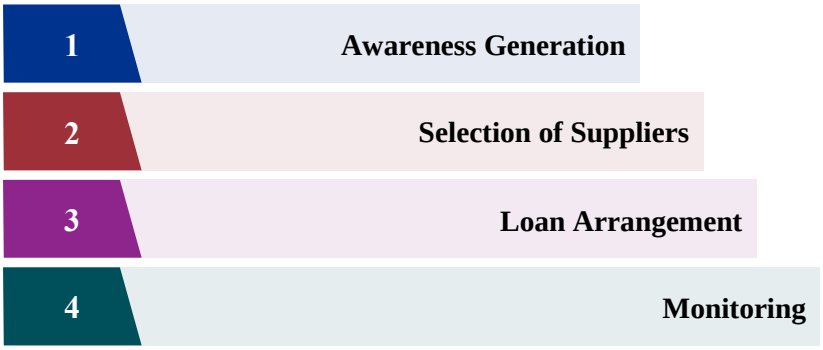
- Minimum dependence on state subsidy
- Scalable model – have the potential to replace most of the diesel pumps
- Greater involvement of the beneficiaries – due to larger investment

Critical Success Factors

- Pro-activeness of suppliers/RRBs/NABARD to spread awareness about the program
- Availability of security with farmers – land is already mortgaged to its full value in some of the cases
- Willingness of the suppliers to enter into tripartite agreement for asset buy-back

Implementation Roadmap

The following roadmap could assist the states in implementing the solar pump programme based on the above described model. Each step is described in detail below:



1 Awareness Generation

- NABARD can initiate the programme by building awareness of the programme amongst the RRBs/Commercial banks.

2 Selection of Suppliers

- The suppliers would be empanelled through an e-tendering process at the national level conducted by MNRE in collaboration with NABARD.
- It is important that the shortlisted suppliers conduct demonstration workshops and market their products to generate demand.
- The beneficiary will have choice of suppliers among the shortlisted.

3 Loan Arrangement

- The beneficiary would be free to go to any of the RRBs/Commercial banks' branches and avail subsidy along with loan for the remaining amount as per terms and conditions of the participating bank.
- The beneficiaries would repay the loan amount to the banks over the loan tenure.
- A tripartite agreement can be signed by the suppliers for asset buy back at certain percentage of the total cost to avoid issues around bankability.

- The State Government may also consider subsidizing loan interest rates for the beneficiaries.

4 Monitoring

- For pumps promoted through NABARD, additionally, a status report by the empanelled suppliers would have to submit on biannual basis.

2.2.3.5 Model 5: "Water as service" model

Model Description

This model may be targeted to large farmers or community who can anchor the solar pump system and supply water to other farmers (pay-per-use model). The shared pumping infrastructure improves utilization of the pumps and hence the affordability to pay (either upfront or gradually). Thus the contribution of beneficiary may be higher.

The funding pattern under this option is described in Figure 7 as follows:

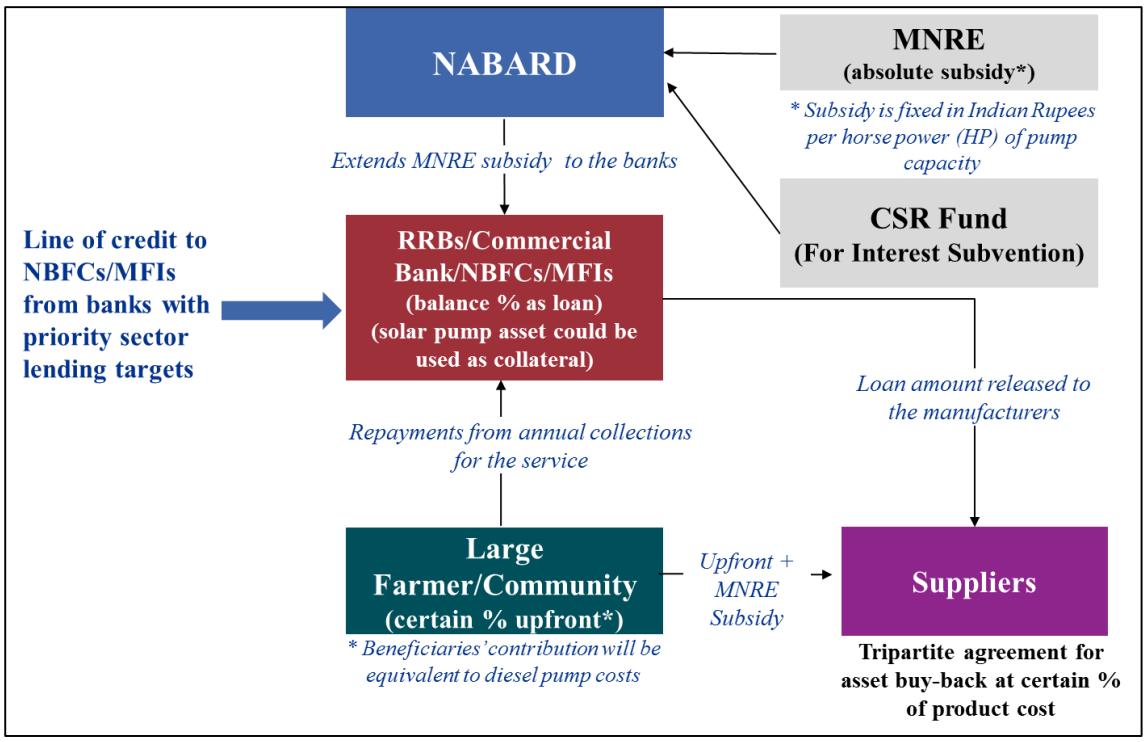


Figure 7: Model 5- "Water as a service" Model

- The Ministry will place central subsidy with NABARD to finance the pumps through RRBs/ Commercial Banks. NABARD will also extend the MNRE subsidy to the RRBs/ Commercial Banks in absolute amount as provided in Annexure III.
- The beneficiary upfront contribution – certain percentage of the cost.
- Balance contribution as loan to beneficiary through RRBs/ Commercial Banks. The beneficiary could be free to go to any of the RRBs/ Commercial Banks' branches and avail subsidy along with loan for the remaining amount as per terms and conditions of the participating bank. Solar pump asset may also be used as collateral by the banks if suppliers are willing to buy back the asset.
- The beneficiaries would repay the loan amount to the banks over the loan tenure.

Salient Features and Critical Success Factors

Salient Features

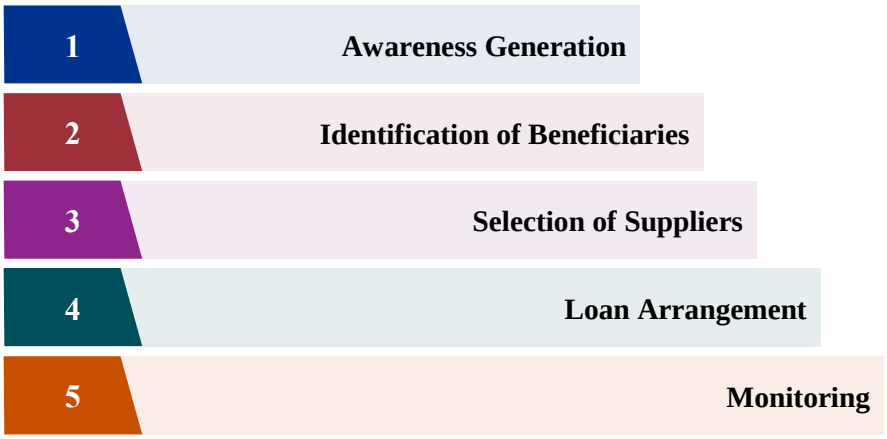
- The shared pumping infrastructure improves utilization of the pumps and hence the affordability to pay (either upfront or gradually)
- The pumps would be owned by large farmers or community - This could help to develop local enterprises increasing local employment opportunities

Critical Success Factors

- Buy-in from the consumers to pay for water usage
- Pro-activeness of suppliers/RRBs/State Implementing Agencies to spread awareness and convince large farmer/community
- Willingness of the suppliers to enter into tripartite agreement for asset buy-back

Implementation Roadmap

The following roadmap could assist the states in implementing the solar pump programme based on the above described model. Each step is described in detail below:



1 Awareness Generation

- NABARD can initiate the programme by building awareness of the programme amongst the RRBs/Commercial banks.

2 Identification of Beneficiaries

- It is essential to identify large farmer or community who can anchor the solar pump system and supply water to other farmers.

3 Selection of Suppliers

- The suppliers would be empanelled through an e-tendering process at the national level conducted by MNRE in collaboration with NABARD.
- It is important that the shortlisted suppliers conduct demonstration workshops and market their products to generate demand.

- The beneficiary will have choice of suppliers among the shortlisted.

4 Loan Arrangement

- The beneficiary would be free to go to any of the RRBs/Commercial banks' branches and avail subsidy along with loan for the remaining amount as per terms and conditions of the participating bank.
- The beneficiaries would repay the loan amount to the banks over the loan tenure.
- A tripartite agreement can be signed by the suppliers for asset buy back at certain percentage of the total cost to avoid issues around bankability.
- The State Government may also consider subsidizing the loan interest rates for the beneficiaries.

5 Monitoring

- For pumps promoted through NABARD, additionally, a status report by the empanelled suppliers would have to submit on biannual basis.

2.2.4 Roles and Responsibilities of Various Stakeholders

This section highlights the key roles and responsibilities of various stakeholders in the solar pump programme under various implementation models described above.

Stakeholders	Model 1	Model 2	Model 3	Model 4/ Model 5
Central Level				
1. MNRE	▪ Overall programme administration – setting up dedicated team and high powered committee for overseeing implementation ▪ Inviting EOI from the states, empanelment of manufacturers etc. ▪ Ensuring effective co-ordination between various departments/ministries for integration of schemes and exploring opportunities to leverage subsidy ▪ Disbursement of central financial assistance to implementing agencies ▪ Assistance in generating awareness for the programme • Assistance in Monitoring of the programme's efficacy			
Specific Roles		▪ Assist in identifying funding agencies for the states and facilitating and co-ordination with DEA		

Stakeholders	Model 1	Model 2	Model 3	Model 4/ Model 5
2. Ministry of Agriculture/ Other Ministries (Ministry of Drinking Water and Sanitation/ Ministry of Water Resources)	▪ Ensuring effective co-ordination for integration of various schemes ▪ Assistance in generating awareness for the programme ▪ Assistance in training and capacity building of key stakeholders by integrating them under their current programmes.			
3. NABARD	NA	▪ As a financing agency to provide loan to the State Government.		▪ Administration of the entire programme ▪ Extends MNRE's subsidy to RRB/Commercial Bank ▪ Refinance to lending institutions as required ▪ Building awareness for RRBs
State Level				
1. State Implementing Agency (State Nodal Agency/ Agriculture/ Horticulture department/RE department	▪ Overall programme implementation ▪ Identification of targets for implementation ▪ Integration of various schemes ▪ Leveraging subsidy from other schemes/State Budget ▪ Selection of suppliers/ RESCOs ▪ Disbursement of MNRE subsidy, State subsidy and beneficiaries contribution to the manufacturers ▪ Monitoring and Evaluation of the programme ▪ Assistance in creating awareness – site visits, campaigns etc.			

Stakeholders	Model 1	Model 2	Model 3	Model 4/ Model 5
Specific Roles	NA	▪ Releasing loan from State Govt. to the manufacturers	▪ Releasing annual payment to RESCOs from savings on net cost of agriculture power supply	▪ Assistance in co-ordination with the manufacturers ▪ Assistance in awareness generation ▪ Assistance in monitoring and evaluation
2. State Government	• Allocating funds from State budget	▪ Borrow from lending agencies ▪ Extending loan amount to the implementing agencies for payment to the manufacturers ▪ Loan servicing from savings on net cost of agriculture power supply ▪ Tapping subsidy savings of the Utilities	▪ Divert savings on net cost of agriculture power supply for servicing to RESCO ▪ Appropriate Guarantee mechanism for RESCOs ▪ Tapping net cost of agriculture power supply savings of the Utilities ▪ Allocating funds from state budget	▪ Allocating funds from State budget (Option B)
3. Distribution Companies	NA	▪ Diverts savings on net cost of agriculture power supply to the State Government		NA

Stakeholders	Model 1	Model 2	Model 3	Model 4/ Model 5
District Level				
1. District level Implementing Agency	▪ Inviting applications from farmers and selected beneficiaries ▪ Releasing payment to the suppliers/ RESCOs based on various milestones ▪ Assistance in monitoring and evaluation of the programme- conducting physical inspections and verification at the site and issue status reports during the installation process			NA
Others				
1. Banks like RRBs/ Commercial Banks	NA	NA	NA	▪ Lending to beneficiaries through own sources or refinance ▪ Ensure robust recovery mechanisms in case of credit default
2. Multilateral/ Bilateral or any other lending agencies	NA	▪ Provide grants/funds to the State Government	NA	NA
3. Beneficiaries	▪ Application for installation of solar pumps ▪ Providing upfront contribution ▪ Selection of manufacturers ▪ Providing space and water arrangement/tank for the installation of the SPV pump system ▪ Routine maintenance of the system – safety, cleaning panels, reporting damages etc.			

Stakeholders	Model 1	Model 2	Model 3	Model 4/ Model 5
Specific Roles	NA			▪ Greater upfront contribution ▪ Borrow from banks ▪ Providing security ▪ Repayment of loan ▪ Providing water as service (Model 5)
4.Manufacturer/ Supplier	**Installation** ▪ Supplying the complete SPV pump system on the site as per MNRE technical specifications for the solar pump system ▪ Installation and commissioning of the system **Insurance** ▪ Insurance of the system against fire and burglary during the guarantee period ▪ Assist the beneficiary to file insurance claim to bring the claim to a final settlement **Maintenance** ▪ Installing workshops in the states for repair and maintenance ▪ Providing maintenance guarantee for five years as well as additional after-sales service for five years ▪ Establishing a customer care center and toll free number and upload the data on departmental website ▪ Arrange quarterly inspections of solar pump units. ▪ Stock adequate spare parts so that unit becomes operational within five days of complaint **Awareness generation** ▪ Assistance in generation of awareness – pilot demonstrations etc.			

Chapter 3
Communication Strategies

3 Communication Strategies

This section covers various communication strategies which can be adopted by states to ensure that the programme is extensively communicated through various channels and a strong capacity building framework is provided for all stakeholders.

In a large scale solar pump programme, effective communication plays an important role in generating demand and creating awareness about the programme amongst all the key stakeholders.

A. Modes of Communication

The State Implementing Agency may adopt the following modes of communication to create awareness and effectively publicize the solar pump programme:

Awareness Programmes

The awareness programme under the solar pump scheme could be combined with existing awareness programmes under the Information, Education and Communication (IEC) division under Ministry of Rural Development (MoRD) and Indian Council of Agricultural Research under Ministry of Agriculture. The IEC division in the MoRD is responsible for planning and executing IEC activities to create awareness about the programmes of the Ministry primarily amongst the target groups in the rural areas. MNRE can coordinate with MoRD to bring awareness programme for solar pump under this division.

This awareness programme can be targeted towards farmers and bankers in collaboration with solar pumping vendors and suppliers. This will facilitate the farmers to decide their financing options through various loan schemes offered by the banks. MNRE along with State Implementing Agency could collaborate with existing agriculture universities in India to introduce an awareness and training programme focusing on technical literature, demonstration pumps and pilot installations. NABARD may organize programmes for creating awareness for RRBs.

Media

MNRE and the State Implementing Agency may coordinate with the Central Sector Scheme "Mass Media Support to Agriculture Extension" under the Ministry of Agriculture. The scheme aims to revamp the extension services in the country by using electronic media for transfer of technology/information to the farmers and other stakeholders. Mass dissemination of information & spread of technologies through the use of Television, Print Media and Radio can be done. *Prasar Bharati* is currently implementing this scheme through the countrywide network of *Doordarshan* and All India Radio.

A 24 hour *Kisan* Channel "*DD Kisan*" dedicated to agriculture and related issues and providing real-time information to farmers, has been announced in the Union Budget 2014-15. This channel could be used as a platform to aware farmers of the solar pump programme and its benefits.

Demonstrations by the Suppliers

It is necessary that the State Implementing Agency organizes demonstration camps in target districts where the suppliers will demonstrate the working of their product and highlighting the key features. This could generate demand and help the farmers to decide which supplier to choose. The District Implementing Agency can distribute easy to read, image based guidebooks and video clips in the local languages that would have been developed by the suppliers.

Site Visits

The publicity needs to be backed with key officials' regular site visits to increase awareness. Officials from the State and District Implementing Agencies can make extensive field visits to

different villages and interact with farmers. This will create an effective impact on the local farmers to adopt solar pumps for use in agriculture purposes.

Implementing Pilot Solar Agriculture Pump Schemes

The State and District Implementing Agencies could also work on implementing pilot solar agriculture pump schemes in the identified districts by working with suitable agencies to attain the objectives of bringing awareness.

B. Training and Capacity Building

A cohesive strategy needs to be formulated to help build the capacity of various stakeholders. The capacity building could take place by the following measures:

- The State Implementing Agency can combine training and capacity building programme for the solar pump programme with existing training programmes under Ministry of Rural Development and Ministry of Agriculture and programmes under the National Skill Development Corporation and Industrial Training Institutes. The Ministry of Rural Development gives emphasis on capacity building of rural development functionaries and other stakeholders to enhance the effectiveness of implementation of various rural development programmes across the country. MoRD also provides financial assistance for organizing training courses/seminars/workshops under the Scheme "Organization of Training Courses". It supports the training activities of States for effective implementation of rural development programmes by providing financial support to State Institutes of Rural Development (SIRDs) and Extension Training Centres (ETCs) to impart training in the field of rural development to Rural Development Functionaries and elected representatives of Panchayati Raj Institutions and others at State level and at District/Block level.
- The training could be conducted for different stakeholders at each level (State, district and village) on different aspects of the programme such as implementation models of the programme, proper use of the pumps, their maintenance and other aspects of reporting and monitoring. The State Implementing Agency can also initiate exposure programmes for last mile conventional electric pump shop owners that would help making them advocates for solar pumps. Training last mile pump technicians would develop a chain of 'solar pump ministries' (technicians) to provide after sales services.
- The pump suppliers can be encouraged to develop product training modules and user guide for selection of right pump suitable to local cropping, soil and water needs for technical capacity enhancement at various levels. These product training modules can be designed exclusively for the beneficiaries and can be user-friendly and simple, multi-lingual, educative and visually descriptive, culturally sensitive, easily accessible and distributed by the District level Implementing Agency to the farmers. The suppliers can also conduct training workshops and sessions in collaboration with the District Implementing Agency to train the farmers about the proper use and maintenance of their equipment.

Chapter 4
Monitoring and Evaluation Mechanism

4 Monitoring and Evaluation Mechanism

This section covers various monitoring and evaluation aspects and the tools and technological interventions which ensure quality implementation of the solar pump programme. Monitoring of the programmes is required to ensure effective operation of the solar pump system along with tracking of its performance and benefits.

4.1 Monitoring Aspects

Depending on the evaluation characteristics, the key monitoring aspects can be classified into two types:

- Quantitative aspects: The quantitative aspects of monitoring may include, measurement of power savings, generation of additional income of farmers (through yield improvement, high value crops etc.), pump performance (based on hours of usage, any issues faced etc.), water conservation, employment generation and other usages like lighting, charging etc.
- Qualitative aspects: The qualitative aspects could possibly include, improvement in the livelihood of farmers, convenience and reliability, safety for farmers and identification and traceability of pumps.

State Implementing Agency would be responsible for 100% monitoring of the solar pumps installed in the field. The State Implementing Agency could take up concurrent monitoring and post project evaluation including impact assessment and third party surveys. State may decide to continue with their current institutional arrangement for monitoring or by empanelment of M&E agencies.

4.2 Tools and Technological Interventions for M&E

Various tools and technological interventions could be employed for monitoring and evaluation of the programme:

A. Online MIS Platform for the Solar Pump Programme

A timely information from the field would help to evolve the programme and bring necessary changes based on data collected and feedback from the users. A MIS based information collection system would be put in place. The system will be maintained by the State Implementing Agency and allow key stakeholders to access the web based application for updating the database.

This MIS system will act as an end-to-end software for service delivery and monitoring. The State Implementing Agency will be responsible for appointing a Software Developer to design and operate the MIS platform, through a bid process. The database will be periodically updated by the state and District Implementing Agencies and suppliers. The developer will also be responsible for troubleshooting the software and ensure timely feed of information in the system. The State Implementing Agency will ensure training of the staff handling this system.

B. Remote Monitoring

Each PV module must use a RF identification tag (RFID) for identification and traceability. A GPRS based remote data logging system could be installed with all solar pumps above 0.5 HP. Solar pump systems smaller than 0.5 HP would be selectively monitored through third party surveyors and a small percentage would be fixed with data loggers for field data collection. The State Implementing Agency shall install SCADA (Supervisory Control and Data Acquisition) systems for remote monitoring of the solar pump systems. The suppliers must supply the solar pump-sets such that they can be connected and remotely monitored by SCADA system. The Online MIS system must be capable of taking GPRS inputs from the remote monitoring system.

C. Other Tools for Monitoring

For pumps promoted through NABARD, additionally, a status report by the empanelled suppliers will have to be submitted on biannual basis. Pumps may be metered to estimate the usage and gauge pump performance. A social and technical audit would be conducted by the State Implementing Agency involving local universities and citizen bodies.

4.3 Data Collection and Custodian of Records

The District Implementing Agency may collect and maintain records of the delivery data from the suppliers once the solar pump sets have been delivered to the beneficiaries. The district officers may verify and maintain the details of end-users/recipient post installation of the pumps and submit it to the State Implementing Agency. The beneficiaries could provide field performance data and other relevant feedback to the District Implementing Agencies and M&E agencies which would then provide the feedback to the State Implementing Agency. Field performance data and feedback may be collected by periodical checks and surveys, social impact assessment and after-sales monitoring. All official communication can be documented and copies duly submitted to the State Implementing Agency.

In order to facilitate systematic collection of information at various levels and for complete transparency and accountability, records could be maintained with the respective authorities as provided below:

S.no	Name of the record	Custodian of record	Communicated to
1.	End-user/recipient details	Officers of DIA	SIA
2.	Verification of end-user/recipients	Officers of DIA	SIA
3.	Quality Control and Random trials	M&E agencies	SIA
4.	Aftersales service records	Suppliers	SIA and M&E agencies (if any)
5.	Complaint Register	Officers of DIA	SIA
6.	Collated data on performance/ feedback/ complaints etc.	Officers of DIA	SIA and Central agencies

DIA: District Implementing Agency, SIA: State Implementing Agency

4.4 Grievance Redressal

A platform to address to the grievances of end-users/recipients arising from unsatisfactory after-sales services, non-performance of the product and other programme implementation issues can be set up. The State Implementing Agency will be responsible for designing and operating an appropriate multi-tier redressal mechanism that tackles issues at the concerned level. State level helpline number, customer care centers, 24- hour *Kisan* helplines and online complaint platforms will be a part of this redressal mechanism.

Chapter 5
Other Potential Opportunities

5 Other Potential Opportunities

The states may consider the following opportunities for integration of solar pumps with electricity for lighting/livelihood:

a. **Micro Grid**

- In areas where there is no electricity grid, State Government may facilitate village Panchayats to set up micro-grid and charge farmers based on the electricity consumption – the solar plant feeds power to cluster of pumps in the village.

b. **Feeder Level Distributed Supply**

- In area with electricity grid and having separate agriculture feeders, the state Government may facilitate setting up small (KW scale) solar power plants connecting to the dedicated feeder.

c. **Lighting as part of Solar Pump System**

The suppliers can also look at providing certain value additions to the beneficiaries as part of the solar pump system. Example:

- An outlet which can be used for running fans/light/mobile charging while the farmer is on field.
- One home lighting system.

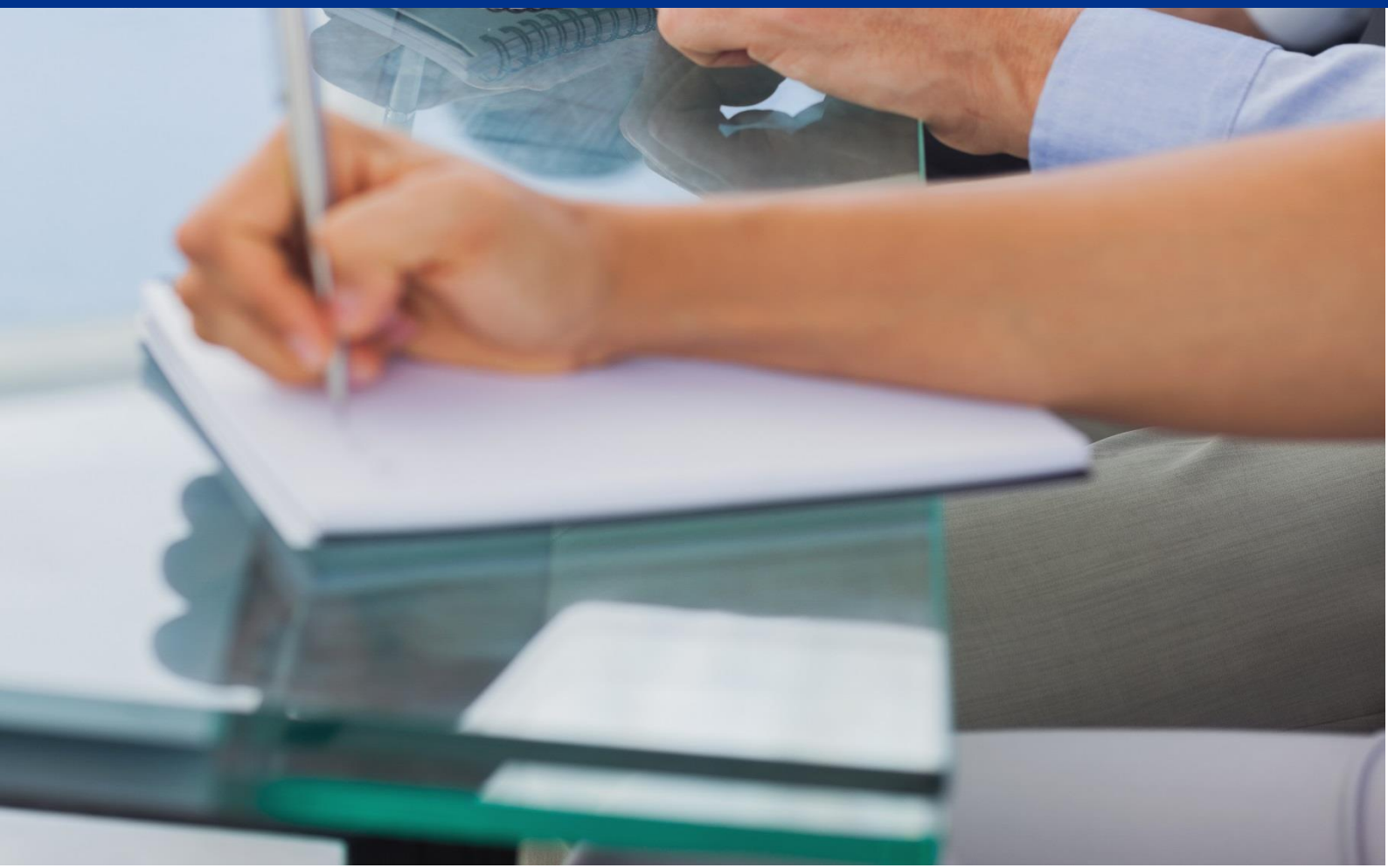
An illustration of integrating solar pumps with access-to-electricity for the state of Rajasthan has been provided in Annexure IX.

d. **Grid Connected Solar Pumps**

- Since irrigation needs are intermittent, in areas where there is electricity grid, the beneficiaries can feed surplus power back in the grid through net metering.
- The Utilities may purchase the surplus power from the beneficiaries at certain tariff.
- In such cases, the flow of power may be unidirectional and beneficiaries may not be allowed to draw power from the grid.

An illustration of benefits to farmers from grid connected pumping is provided in Annexure X. It is also essential to bring in efficiencies in the product supply chain (details provided in Annexure XI). MNRE can also support the implementation of the solar pump programme through Programme Management and Research and Development (R&D) as described in Annexure XII.

Chapter 6
Annexures



Annexure I- Economic Viability of Diesel Replacement with Solar Pumps

The following table provides illustration for the economic viability of replacement of a 3 HP (2.2 kW) diesel pump with a solar pump.

1	Indicative average price of a 2.2 kW solar pump system (INR)	300,000
2	Indicative average price of a conventional diesel pump system (INR)	60,000
3	Incremental contribution required (INR) (1 – 2)	240,000
4	Annual diesel expenditure saving[1](INR)	48,400
5	Benefit of crop yield improvement (by 10%) (INR)	20,000
6	Total annual benefits (4 + 5) (Escalated at 3 percent per annum) (INR)	68,400
7	Break even period (without considering cost of capital)	**~ 3.5 years**

[1]*Assuming 6 hours a day for 200 days; 1 litres of diesel ~ 3 units of power; INR 55/litres of subsidized diesel*

Annexure II– Selection of Target Districts for Implementation

The states can identify target districts for solar pump implementation considering various factors as described in Table 1 below. Based on the data obtained for these factors, the states may then provide relative ranking to the districts as provided in the Illustration in Table 2 below.

Table 1: Factors and Data source for selection of target districts

S. No.	Factor	Source of data	Action point for the state
1	Water table depth	▪ District wise water table depth data can be accessed through the District Ground water brochures published by the Central Ground Water Board for every state (http://cgwb.gov.in/District_Profile/AP_districtProfiles.html) ▪ The data can also be available with state department for water resources. *for example*: the Gujarat Water Resource Development Corporation is responsible for ground water investigation, exploration, management & recharge works in the State of Gujarat (http://www.gwrdc.gujarat.gov.in/)	▪ The states may look at the trend of water table depth for the past 3-5 years depending on latest data available for that state. ▪ The states may also approach the respective department of water resources for district wise water table depth data. ▪ Depending on the data obtained, the states may identify the districts with better water tables
2	Number of pending electric pump connection/diesel pumps	▪ District wise number of diesel pumps can be obtained from the Agricultural census, department of Agriculture and Cooperation (http://agcensus.nic.in/) ▪ The number of farmers who have pending electricity connections can be available with the state DISCOMs	▪ States may approach the respective DISCOM for the data on the number of pending connections. ▪ Based on the data, the state may target districts with greater number of farmers in queue for electric pumps followed by districts with greater diesel pump owners.
3	Area under micro-irrigation	▪ This data can be available with the State Horticulture department/ Agriculture department ▪ Some states have formed Special Purpose Vehicles/ for the implementation of Micro Irrigation scheme and can provide data on district wise area under micro irrigation. *for example:* Gujarat Green Revolution company (http://www.ggrc.co.in/frmhomepage.aspx)	▪ The states may identify districts having larger area under micro-irrigation
4	Average size of landholdings	▪ This data is available with the Agricultural Census Division, department of Agriculture and Cooperation (http://agcensus.dacnet.nic.in/districtsummarytype.aspx)	▪ The states may identify districts with farmers having medium to large size of landholdings
5	Farmer income	▪ Data for district wise type of crops grown can be available with State department of	▪ The states may approach the department of agriculture/

S. No.	Factor	Source of data	Action point for the state
		agriculture/ State department of economics and statistics. *for example* (http://www.tn.gov.in/crop/Districttables.htm) ▪ Details of farmers availing tractor loans in a particular district can be available with the Regional Rural Banks (RRBs) in the state	department of economics and statistics for data on types of crops grown in the state and identify districts growing high value/ marginal crops ▪ The states may also approach RRBs to identify farmers with tractor loans These will provide an indication of the farmers' income category in the district.

Based on the factors as described in Table 1, the districts can be identified and ranked relatively on a scale from 1 to 5, 5 being the highest, and an overall score can be calculated for each district in a particular state as shown in Table 2.
For example, for a particular state, districts having better water table could be scored a 5 (as better water table could be favorable for solar pump) and districts having higher water table depths could be proportionately scored 4,3 and so on. Districts with higher scores can be potentially targeted first followed by others.

Table 2: Illustrative scoring table for ranking districts

	Water table depth	**Number of pending electric connection/diesel pumps**	**Area under micro-irrigation**	**Average size of landholdings**	**Farmer income**	**Overall Score**
	Score (Out of 5)					**Out of 25**
District 1						
District 2						
District 3						
District 4						
District 5						

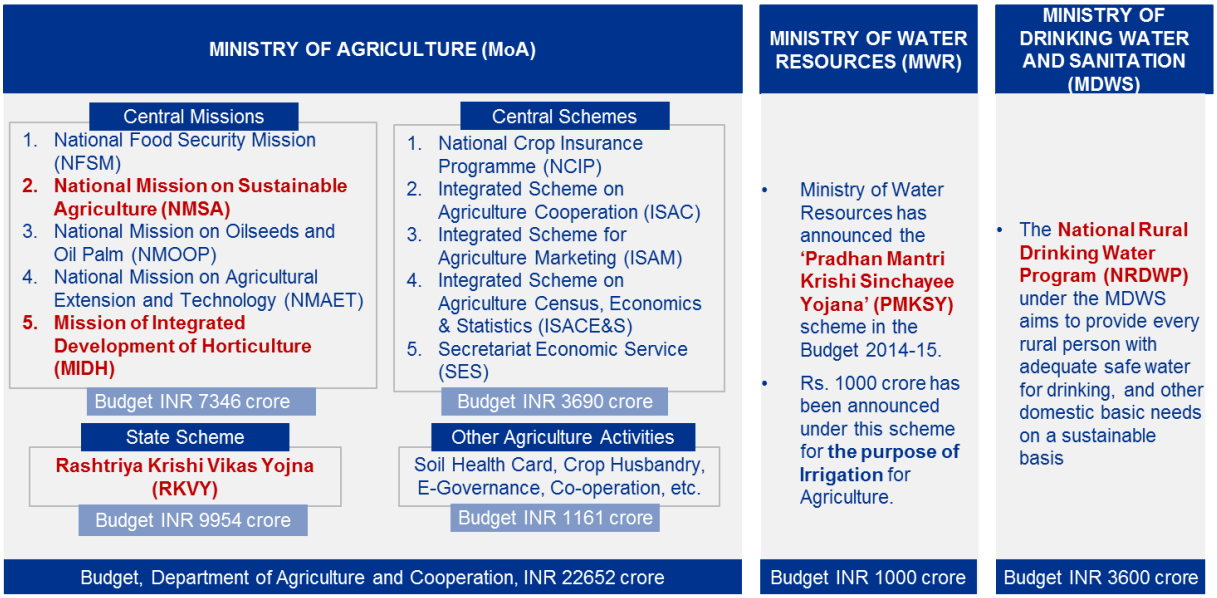
Annexure III- Central Financial Assistance (Rs/HP) for SPV Water Pumping System

							INR per HP
S. No.	**SPV System**	**Capacity**	**General Category States**	**Through NABARD**	**NE States, A&N, Lakshadweep Islands**	**Special Category States**	**Channel Partners**
1	DC Pumps	Up to 2 HP	43200	57600	47520	43200	41000
		>2HP to 5HP	40500	54000	44550	40500	38500
2	AC Pumps	Up to 2 HP	37800	50400	41580	37800	36000
		>2HP to 5HP	32400	43200	35640	32400	30700
		>5 HP to 10 HP*	28800	38880	32076	29160	27630

*SPV water pumping system over 5HP may avail subsidy under State Government Schemes where ever applicable. MNRE subsidy will be limited to 5 HP only even for higher capacity pumps till any revision in the Scheme.

Annexure IV- Relevant Schemes for Integration with Solar Pump Programme

Government of India is currently implementing a number of programmes and schemes to benefit farmers and rural population under various ministries. These have been outlined in Figure 8 as follows:



**Note: The above budget numbers are for the budget allocated under various schemes for the year FY 14-15*

Figure 8: Overview of schemes and programmes of Government of India

The relevant schemes for integration with solar pumps are:

1. National Mission for Sustainable Agriculture (NMSA)

The objective of the mission is to promote sustainable agriculture by converging, consolidating and subsuming the activities/programmes under Rainfed Area Development, On Farm Water Management, Soil Health Management and Climate Change and Sustainable Agriculture.

NMSA architecture has been designed by converging, consolidating and subsuming all ongoing as well as newly proposed activities/ programmes related to sustainable agriculture.

- During the XII Plan, with effect from 2014-15, it was decided to subsume the National Mission on Micro Irrigation (NMMI) under NMSA. NMMI, is being implemented since the year 2010 to promote the use of drip irrigation system in the country.
- The subsidy pattern under this scheme would be:
    - 35% will be borne by the Central Government, (additional 10% for small and marginal farmers)
    - 10% by the State Government (varies from 10-50% for different states) and
    - remaining borne by the beneficiary

2. Mission for Integrated Development of Horticulture (MIDH)

The objective of this mission is to integrate all activities for development of horticulture sector: National Horticulture Mission, National Bamboo Mission, Coconut Development Board etc.

- Mission for Integrated Development of Horticulture (MIDH), a Centrally Sponsored Scheme is proposed to be implemented during XII Plan.
- This Mission subsumes and integrates the activities and schemes under horticulture. The National Horticulture Mission (implemented since 2005-06), has now been subsumed under MIDH.
- Under the Mission, assistance will be provided for
  - Creation of Water harvesting structures, 50% (42.5% GOI and 7.5% State)
  - Protected cultivation, 50% (42.5% GOI and 7.5% State)
- Of the total Financial Outlay of MIDH, creation of Water Harvesting structures has been allocated ~6% of the total funds.

3. Rashtriya Krishi Vikas Yojana (RKVY)

The Scheme aims to incentivize the States to increase investment in Agriculture and is available for any agriculture activity that can increase production growth in agriculture and allied sectors.

- The Nodal department for the scheme in the states is the State Agriculture department. State identifies the projects that are important for agriculture, horticulture and allied sector development
- The state department of agriculture ensures the preparation of the DAPs (District Action Plans) and preparing the SAP (State Action Plan) and the determination of eligibility and amount of money allocated is done by Planning Commission (Figure 9).
- Once the state becomes eligible, the Distribution of Funds is done by the Department of Agriculture (DAC), under the Ministry of Agriculture.

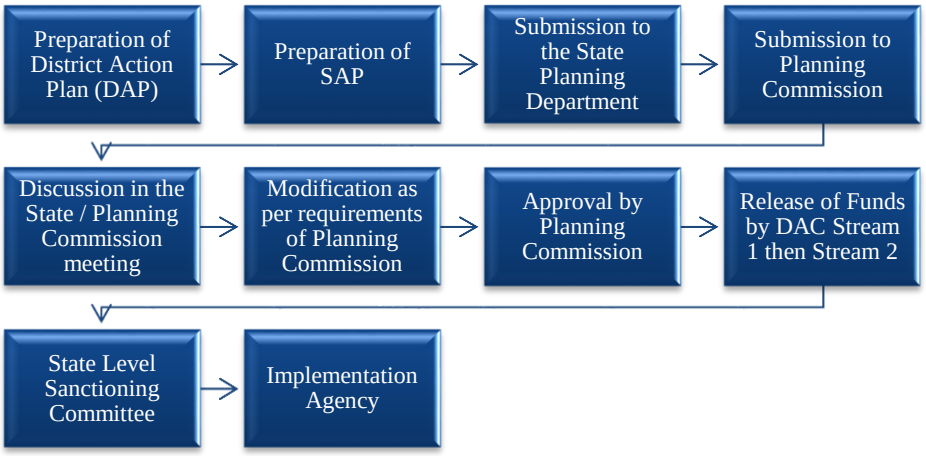


Figure 9: Implementation flow of RKVY

4. Pradhan Mantri Krishi Sinchayee Yojana' (PMKSY) scheme

The 'Pradhan Mantri Krishi Sinchayee Yojana' (PMKSY) scheme has been announced in the Budget for 2014-15 under the Ministry of Water Resources (MWR). INR 1000 crore has been announced under this scheme for the purpose of irrigation for agriculture. States may decide to leverage funds from this programme towards the solar pump programme for irrigation.

5. National Rural Drinking Water Program (NRDWP)

This programme under the Ministry of Drinking Water and Sanitation aims to provide every rural person with adequate safe water for drinking, cooking and other domestic basic needs on a sustainable basis:

NRDWP along with the National Clean Energy Fund (NCEF) also funds the **Solar Dual Pump Water Supply Scheme**.

- This Scheme aims to install solar energy based dual pump piped water supply schemes for supply of drinking water to 10000 rural habitations in 82 districts.
- This is a fully subsidy driven scheme, where 60% of the project cost is funded through the NRDWP *(co-funded by central and state governments on a 50:50 sharing basis)* and 40% of the total project cost is funded through the National Clean Energy Fund.

6. Other programmes

Ministry of Rural Development implements various schemes for the development of rural population and infrastructure. Some of these schemes like Providing Urban Amenities to Rural Areas (PURA) programme could be looked by the states for integration.

States may also look at additional sources of funds through the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY scheme- for rural electrification) under the Ministry of power.

Annexure V - Specifications of the proposed models of SPV pump for irrigation

1. Standards/Quality:

A. PV Array

The SPV water pumping system for irrigation and domestic drinking water should be operated with a PV array capacity in the range of 75 Watts peak to 5000 Watts peak, measured under Standard Test Conditions (STC). For municipalities and rural drinking water supply, installations less than 5 kWp of array size would be considered. Sufficient number of modules in series and parallel could be used to obtain the required PV array power output. The power output of individual PV modules used in the PV array, under STC, should be a minimum of 74 Watts peak, with adequate provision for measurement tolerances. Use of PV modules with higher power output is preferred.

Indigenously produced PV module (s) containing mono/ multi crystalline silicon solar cells should be used in the PV array for the SPV Water Pumping systems.

- Modules supplied with the SPV water pumping systems should have certificate as per IEC 61215 specifications or equivalent National or International/ Standards.
- Modules must qualify to IEC 61730 Part I and II for safety qualification testing.
- The efficiency of the PV modules should be minimum 14% and fill factor should be more than 70%.
- The terminal box on the module should have a provision for "Opening" for replacing the cable, if required.

B. Motor Pump-Set

The SPV water pumping systems may use any of the following types of motor pump sets:

1. Surface mounted motor pump-set
2. Submersible motor pump set
3. Floating motor pump set
4. Any other type of motor pump set after approval from Test Centres of the Ministry.

The "**Motor Pump Set" for irrigation and domestic drinking water should have a capacity in the range of 0.1 HP to 5 HP. Municipal and rural community applications could choose a higher capacity solar pump.** In case of clustering of pumps in a solar pump micro grid each pump load should not exceed 5 HP. Solar Pumps should have the following features:

- The mono block DC/ AC centrifugal motor pump set has its driving unit and impeller mounted on a common shaft, thereby giving it a perfect alignment. The pump should be provided with specially developed mechanical seals which ensure zero leakage.
- The motor is of 0.1-5 HP having spring loaded carbon brushes in case of D.C. Motor Pump Sets. The suction and delivery head will depend on the site specific condition of the field.
- Submersible pumps could also be used according to the technical need of the particular case.
- The suction/ delivery pipe (GI/HDPE), electric cables, floating assembly, civil work and other fittings required to install the system.
- The following details should be marked indelibly on the motor pump set:
  Name of the Manufacturer or Distinctive Logo, model Number and serial Number.

C. Mounting Structures and Tracking System.

The PV modules should be mounted on metallic structures of adequate strength and appropriate design, which can withstand load of modules and high wind velocities up to 150 km per hour. The support structure used in the pumping system should be hot dip galvanized iron with minimum 80 micron thickness.

To enhance the performance of SPV water pumping systems above 0.5 HP, manual or passive or auto tracking system **must** be used. For manual tracking, arrangement for seasonal tilt angle adjustment and three times manual tracking in a day should be provided. For smaller pumping system, less than 0.5 HP a fixed mounting structure would be permitted. In areas where security of solar panels is a concern it would encouraged to mount solar pumps on movable trolley. A portable solar pumping system with mounting of solar panels on a movable trolley, with tracking for above 0.5 HP pump and without tracking for less than 0.5 HP pumps, would be allowed.

D. Electronics And Protections

- Maximum Power Point Tracker (MPPT) should be included to optimally use the Solar panel and maximize the water discharge.
- Inverter could be used, if required, to operate an A.C. Pump.
- Adequate protections should be incorporated against dry operation of motor pump set, lightning, hails and storms. Full protection against open circuit, accidental short circuit and reverse polarity should be provided.

E. On/Off Switch

A good reliable switch suitable for DC / AC use is to be provided with the motor pump set. Sufficient length of cable should be provided for inter-connection between the PV array and the motor pump set.

Testing: Following organisations will provide technical help and testing facilities. They will be strengthened with support from MNRE

a. National Institute of Solar Energy (NISE) Gurgaon
b. EQDC, Ahmadabad
c. CPRI, Bangalore
d. International Horticulture Innovation & Training Centre, Jaipur

2. Technical Specifications:

For D.C. Motor Pump Set with Brushes or Brushless D.C. (B.L.D.C.):

(i) 100 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 meters (Suction head, if applicable, minimum of 7 meters) and with the shut off head being at least 12 meters.

(ii) 55 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 meters (Suction head, if applicable, up to a maximum of 7 meters) and with the shut off head being at least 25 meters.

(iii) 35 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 meters and the shut off head being at least 45 meters.

(iv) 21 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 meters and the shut off head being at least 70 meters.

(v) 14 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 meters and the shut off head being at least 100 meters.

The actual duration of pumping of water on a particular day and the quantity of water pumped could vary depending on the solar intensity, location, season, etc.

For A.C. Induction Motor Pump set with a suitable Inverter:

(i) 90 liters of water per watt peak of PV array, from a Total Dynamic Head of 10 meters (Suction head, if applicable, minimum of 7 meters) and with the shut off head being at least 12 meters.

(ii) 50 liters of water per watt peak of PV array, from a Total Dynamic Head of 20 meters (Suction head, if applicable, up to a maximum of 7 meters) and with the shut off head being at least 25 meters.

(iii) 32 liters of water per watt peak of PV array, from a Total Dynamic Head of 30 meters and the shut off head being at least 45 meters.

(iv) 19 liters of water per watt peak of PV array, from a Total Dynamic Head of 50 meters and the shut off head being at least 70 meters.

(v) 13 liters of water per watt peak of PV array, from a Total Dynamic Head of 70 meters and the shut off head being at least 100 meters.

Annexure VI– Template for Seeking Details for Selection of Beneficiary

THE FOLLOWING PROFORMA IS TO BE FILLED IN BY:

To be filled in by the beneficiary with the assistance of implementing agencies

S. No.	Particulars	Information
1	Name of the Beneficiary	
	Father/ husband's name	
	Address- H no, street etc. (Address for communication)	
	Address: Village, Mandal, District (Address of site for installation of Solar Pumpset)	
2	Mobile No/ alternate mobile no/ Contact No	
3	Aaadhaar card No (If available)	
4	Type of AGL connection	Existing/New
5	Contracted Load	
6	Details of the Agricultural land owned/ leased (*Attach land Passbook Copy)	
7	Details of the Bore well / open well	Dia of Bore well: ……" Total Depth……. Ft Static water level: Pre-monsoon ……. Ft Post- monsoon …….. Ft
8	Type of soil	
9	Extent of shade free land available for installation of SPV structure	
10	Type of crops	

11	Details of existing pump sets (diesel/electric)	
12	Area of land under micro-irrigation (if any) in Ha	
13	Existing loan (if any)	

1. DECLARATION:

I / We hereby declare that the particulars given above are true and correct to the best of my/our knowledge and belief. I / We hereby authorize ----------to disclose all or any particulars or details of information furnished in the application to the government or any other agencies as may be considered necessary or desirable.

It will be in order for --------- to disqualify me/us from receiving any solar pump set in case, it is proved that the information declared above contain misrepresentation of facts.

I/We hereby undertake to abide by the terms and conditions that ---------- may stipulate in providing the solar pump-set scheme.

Signature of the Applicant

Place

Date

Annexure VII – Loan Amount Supported at Different Levels of Cost of Agriculture Power Supply

Illustration

For example, a state decides to install 10000 pumps, each of 3 HP pump (2.2 kW). It is assumed that farmers are provided electricity for free. As solar power will replace conventional power, the entire cost of supply can be saved. At different cost of supply of agriculture power for Discom, the net present value of savings for 10 years is calculated in the tables below. The Net Present Value provides an indication of the % of the loan amount which can be borrowed by the Discom/ relevant state agencies and can be repaid using the savings of the cost of agriculture power supply. Additionally, savings of one time network connection cost (say, INR 45000, per connection) which is around 15% of the total cost of solar pumps can also be used to support the solar pump programme.

Thus the total % of solar pump cost which can be taken as loan at different cost of power supply is provided in Table 2 below:

Table 1: Assumptions

No of pumps	10000	Nos.
Solar pump system	2.2	kW
Hours in a year	1200	hours
Units replaced	2640	units
Cost per pump	300000	INR
Total cost	300	crore
Escalation in power cost	3%	p.a.

Table 2: Illustration of loan amount at different level of cost of agriculture power supply

Agriculture (Cost of Supply) (INR/unit)[1]	**NPV[2] (of saving for 10 years at 10%) - crore**	**% of total cost (A)**	**Savings on one time connection cost by Utilities (% of project cost) (B)**	**Total (% of total cost) (A+B)**
4	67	22%	15%	37%
5	83	28%	15%	43%
6	100	33%	15%	48%
7	116	39%	15%	54%

[1] Cost of agricultural power supply (as per Tariff orders of respective states for FY 2015-16) : Punjab INR 5.78/kWh, AP INR 6.79/kWh, Karnataka INR 5.11/kWh

[2] Discount rate is assumed to be 12% p.a.

Annexure VIII – Case Study – Implementation of Loan Model in the state of Andhra Pradesh

- As on July 2015, MNRE has currently allotted 6725 number of Solar PV Pump sets to the state of AP. Government of AP targets to install around 50,000 pump set by 2018-19.
- Currently, 4000 pumps have been sanctioned comprising 5HP (3800 nos.) and 3 HP (200 nos.) pumps.
- The project cost for the sanctioned 4000 pumps is estimated to be 192.6 crore and the funding is through loan by PFC which will be repaid by leveraging the savings of net cost of agriculture power supply to the DISCOM.
- The individual contributions of different stakeholders in the funding model are:
  - Subsidy of INR 63.5 crore by MNRE (33% of project cost) - *absolute subsidy of INR 32,400/HP*.
  - Grant of INR 2 crore by Government of A.P. (1% of project cost).
  - Loan of INR 105.4 crore from PFC (54.7% of project cost)- *APDISCOM takes loan from PFC. The title & ownership of asset lie with the respective APDISCOM and the annual loan repayment amount would be recovered through ARR filed every year*.
  - Beneficiary upfront contribution of INR 21.7 crore (11.3% of project cost).

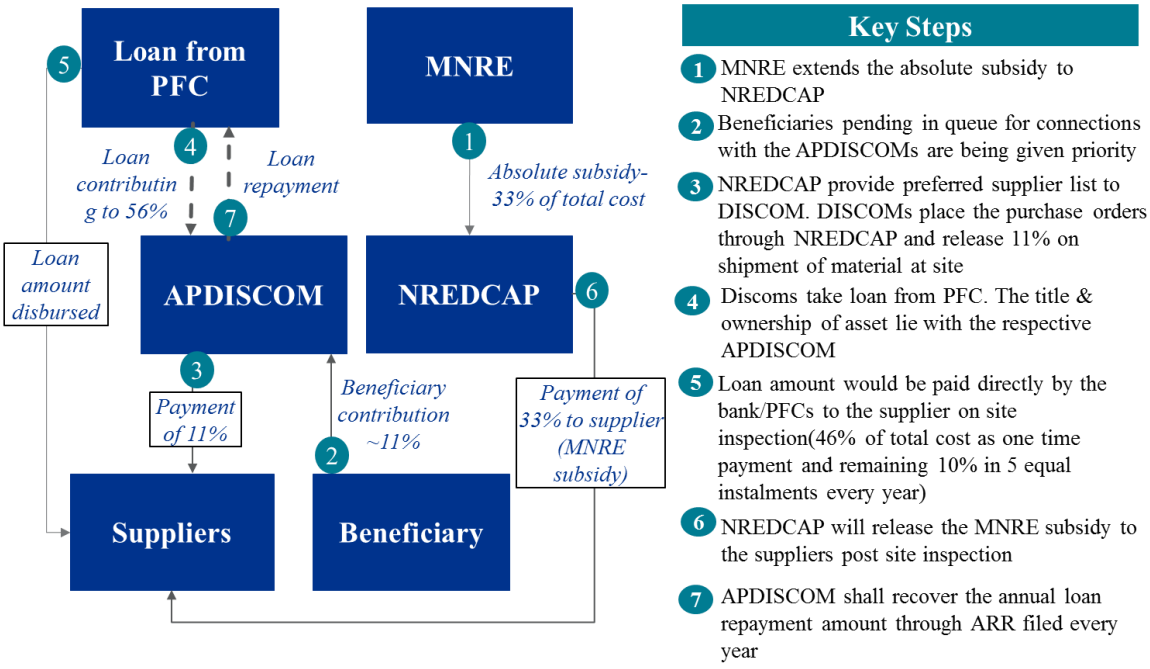


Figure 10: Implementation of Loan Model in Andhra Pradesh

Communication Strategy

- Joint Sessions have been conducted among the NREDCAP and DISCOM regional officials to understand roles, responsibilities and formulating an action plan to spread awareness among the farmers.
- Advertisements with contact details of NREDCAP/DISCOM officials have been circulated extensively in newspapers.

- Demo Setups have been installed at select locations (like DISCOM offices) in different districts to create awareness among farmers.
- Publicity through Word-of-Mouth among the farmers is the main mode of communication.
- In some districts, suppliers have carried out one-to-one communication with farmers and released advertisements in the local TV channels to create awareness.
- District collectors have also been involved in spreading awareness among the farmers and encourage solar pump adoption

Monitoring Mechanism

- Zone wise monthly meetings are planned with suppliers, DISCOM officials, NREDCAP officials headed by Chief Engineers to streamline implementation process.
- Bi-Monthly meetings are planned with advisors to address administrative issues.

Annexure IX- Instances of Integration of Solar Pumping Programmes with objectives of access-to-electricity/ lighting and livelihood- *case of Rajasthan*

Rajasthan has taken concrete steps to support the solar agricultural programme at the state level.

The state had successfully installed over 20,000 solar pump systems till July 2015 and targets to install additional ~5,000-6,000 solar pump systems in the next 1-2 years.

Following are the salient features of the Rajasthan state solar pumping programme:

- The identified implementing agency for the solar pump programme in the state is the Rajasthan Horticulture Development Society (RHDS).
- Rajasthan followed an ***integrated approach*** towards the implementation of the solar pump programme. This included a judicious amalgamation of standalone programmes, mobilization of stakeholders and the creation of synergies to arrive at a comprehensive solution that benefits farmers.
- The following schemes were integrated with the solar pumping programme
  - Rashtriya Krishi Vikas Yojana (RKVY) (currently the state contribution is from state budget).
  - National Horticulture Mission's (NHM) water harvesting structures (WHS) scheme.
  - National Mission on Micro Irrigation's (NMMI) drip irrigation; to provide a composite package to resolve the challenge related to irrigation being faced by farmers.
- The following package for the farmers opting for the solar pump programme was proposed

Funding structure for the programme	**Integration with Drip Irrigation and Water harvesting schemes**	**Integration of solar pumping programs with objectives of access-to-electricity/ lighting**
▪ 30 percent from MNRE ▪ 56 percent from (from RKVY and/or state resources)- (For FY15-16, the subsidy has been revised to 40% (from state budget) ▪ Balance from beneficiaries	▪ Drip irrigation system and facility of water harvesting structure made mandatory with solar pumps	▪ As part of the program, the beneficiaries were supplied with a *solar home lighting system* as an integral part of the solar pump system to provide access-to-electricity to the beneficiaries.

Annexure X– Benefits to the Farmers from Grid Connected Solar Pumps- Net Metering

The table below provides illustration on additional income which a farmer can generate by feeding surplus power back in the grid through net metering.

Illustration: For a farmer using a 3 HP (2.2 kW) solar pump for irrigation.

A	No of pumps	1	No
B	Solar pump system	2.2	kW
C	Days when not used for irrigation	100	days
D	Hours of solar radiation in a day	6	hours
E	Total hours when the pump is not being used (C*D)	600	hours
F	Units replaced (B*E)	1320	units
G	Tariff by Discom	5	INR/unit
	Additional income by beneficiaries (F*G)	**6600**	**INR/annum**

Annexure XI- Improving Efficiencies in the Product Supply Chain/Manufacturing

The Indian conventional electric and diesel pump manufacturing industry caters to the needs of agriculture, domestic, public and industrial sector. The supply chain of this industry, which has last mile linkage to the farmers in rural India, could be empowered to support the development of solar pumping supply chain. There are about 400 pump manufacturers in the three manufacturing clusters in Gujarat, Tamil Nadu and Madhya Pradesh. Training and investment in new technologies can help the existing conventional pump industry to manufacture and service solar PV pumps. A vendor development programme for creating awareness can be a part of the solar pumping programme to enable entrepreneurs in developing efficient supply chain for solar pumps.

Annexure XII– MNRE Support for the Programme

A. Programme Management

To achieve the proposed target, a mission mode approach could be adopted by setting a dedicated team headed by a senior officer of MNRE as chief executive of the programme. A high powered committee could be set as a management advisory board to assist the executive team with knowledge resources for successful implementation of the programme. The committee may consist of experts from solar pumping, efficient irrigation, agriculture, horticulture, rural development, drinking water management, energy efficiency, finance, pump engineering and other allied fields to achieve installation of 1 Million solar pumps. The programme officer and committee could also coordinate with various financing intuitions to enable lending mechanism for the states to implement programmes/schemes that are based on financing.

B. Research and Development (R&D) and Product Development

The Central Government could look at promoting R&D and product development. The key focus of the research could be:

- Increasing the efficiency of pumps - To encourage development of higher efficiency system and a rating system which is similar to Star rating in conventional pumps could be gradually introduced.
- Reducing the cost of balance of systems - Research portfolio would also include cost reduction in solar panel tracking and mounting structures, lower cost Variable Frequency Drives (VFD), low cost electrical interconnects and mobile phone based remote smart metering payment systems.
- Portable solar pump - The product development research may also focus on how to make solar pumps portable. Farmers normally may not want to leave an expensive asset unattended in the farms. They also need power backup at home. Making solar and pump component portable would make it more accessible to the farmers and will open avenues for rent thereby encouraging beneficiaries to be a water service provider.

R&D could be also done for field prototyping of new developments like micro solar pumps, transformer based clustered solar pumps and ultra-high efficiency pumps etc. To support R&D, the data from SCADA monitoring system and online MIS system can be shared by the State Implementing Agency.

About Shakti

Shakti Sustainable Energy Foundation works to strengthen the energy security of the country by aiding the design and implementation of policies that encourage energy efficiency as well as renewable energy. Based on both energy savings and carbon mitigation potential, we focus on four broad sectors: Power, Transport, Energy Efficiency and Climate Policy. We act as a systems integrator, bringing together key stakeholders including government, civil society and business in strategic ways, to enable clean energy policies in these sectors.

(www.shaktifoundation.in)